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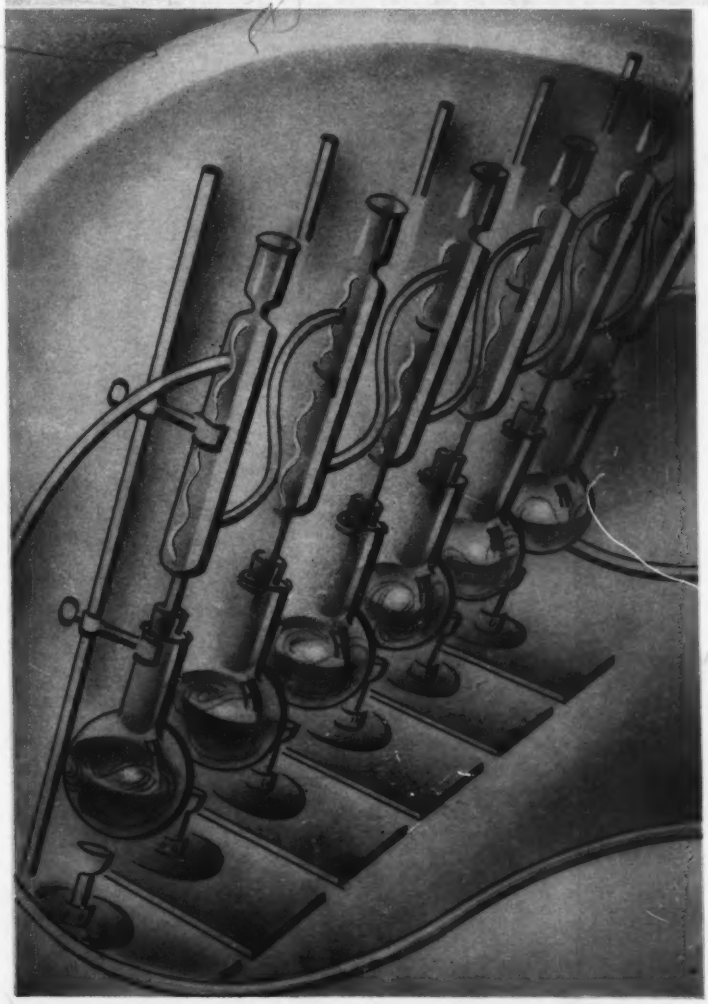

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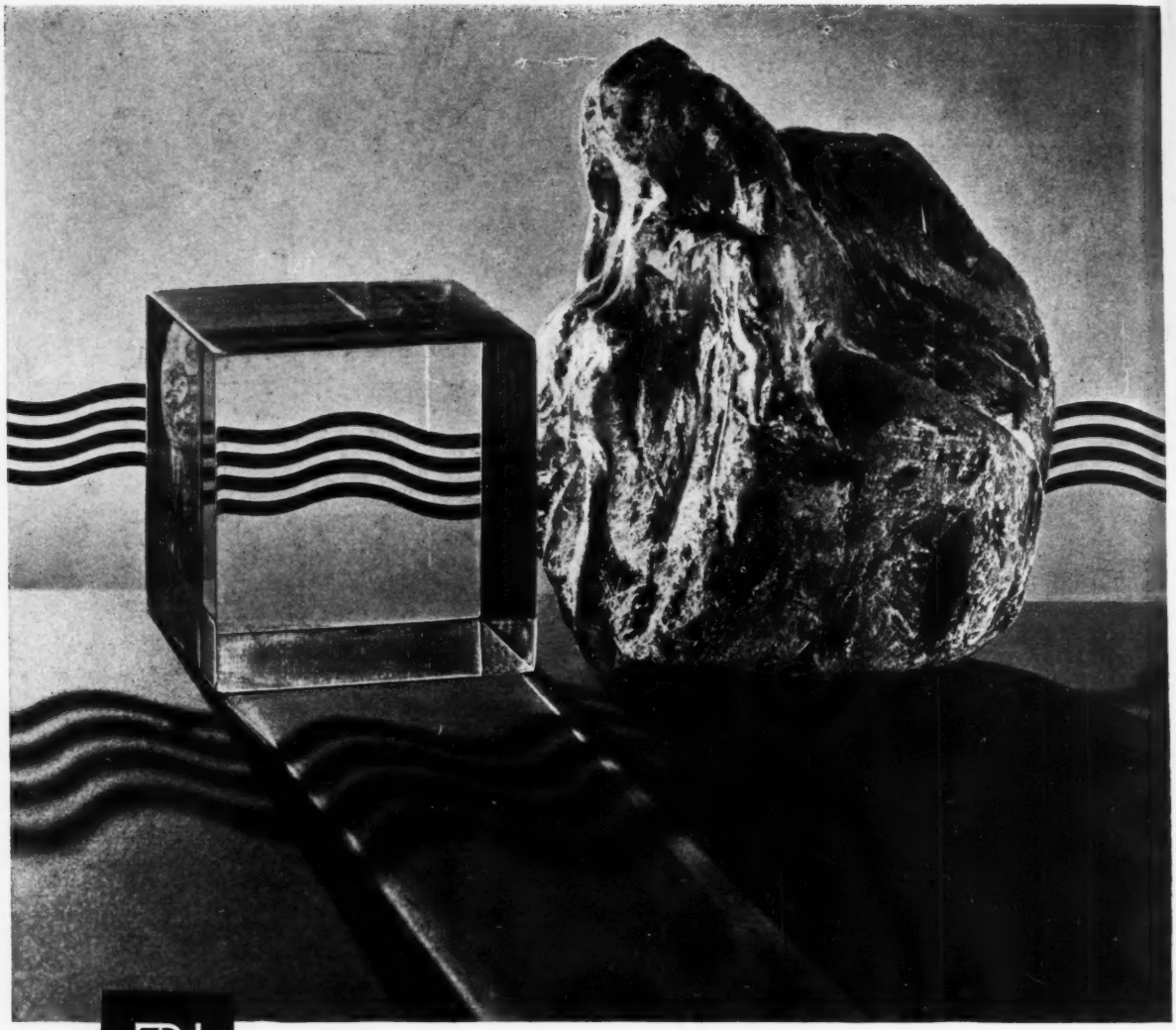

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AMERICAN DYESTUFF REPORTER

A. P. HOWES
Publisher

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NORMAN A. JOHNSON
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Official Publication of the Proceedings of the American Association of Textile Chemists and Colorists

APRIL 29, 1940

VOLUME 29 NUMBER 9

American Dyestuff Reporter, Vol. 29, No. 9, Apr. 29, 1940. Published every other Monday. Copyright, 1940, by Howes Publishing Co., 440 4th Ave., New York, N. Y. Domestic subscription, $5.00, Canadian, $6.00, Foreign, $6.00. Entered as second-class matter, Nov. 6, 1919, at the New York, N. Y., Post Office, under the act of March 3, 1879.

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VOLUME 29 APRIL 29, 1940 NUMBER 9

Concerning the Existence of Fractions of the

Sericin in Raw Silk

HENRY A. RUTHERFORD and MILTON HARRIS*

Abstract

Raw silk fibers consist of at least two proteins, silk fibroin and silk sericin. The latter forms a coating over the fibroin and constitutes 15 to 30 per cent of the total weight of the raw fiber. In practical silk processing, the sericin is generally allowed to remain on the fiber until the fabric is ready to be dyed. In this way, it acts as a protective coating for the silk in the weaving or knitting operations.

Removal of the sericin is usually accomplished with hot soap solutions. The results of numerous studies of this process led earlier investigators to a variety of concepts concerning the state and properties of the sericin in the raw silk fiber. Some stated that the sericin is a single protein substance, whereas others claimed it to be a mixture of proteins which they designated as sericins A, B, etc. The latter concept formed the basis for further claims concerning the desirability of retaining certain fractions of the sericin to improve some ultimate properties of the silk. As many of these claims were based on insufficient experimental evidence, it seemed desirable to make a more extensive investigation of the question of the possible existence of several fractions of the sericin in raw silk.

The results of the present investigation show that the relative yields of the so-called sericins A and B, obtained after treatment of silk in an autoclave, were dependent on the duration of the treatment. Practically all of the sericin removed in the early stages of autoclaving was in the form generally designated as sericin B. On continuing the treatment, this fraction was rapidly converted into the more soluble form, sericin A. Analyses of the fractions, obtained after autoclaving the silk for different lengths of time, showed that the alleged sericins A and B are not definite chemical entities, but are substances whose chemical compositions vary with the duration of the autoclave treatment. It is concluded from these studies that the sericin in raw silk does not exist as a mixture of fractions, but that the fractions are artifacts which result from the hydrolytic decomposition of the naturally occurring sericin during its removal from the raw fibers.

I. INTRODUCTION

RAW silk fibers consist of at least two proteins, silk fibroin and silk sericin. The latter forms a coating over the fibroin and constitutes 15 to 30 per cent of the total weight of the raw fiber. Removal of sericin from fibroin is based on the solubility of the former in hot aqueous solutions. The solubility increases considerably in the more alkaline or acid solutions.

A variety of concepts relative to the nature of sericin and the fractions obtained from it have appeared in the literature. In 1784, one of the first published records on the removal of sericin from silk by the use of alkaline solutions appeared[1]. A number of similar investigations followed until Cramer[2], in 1865, expanded the scope of the investigations and obtained several proteins by fractionation of a solution of sericin. He suggested that these fractions were decomposition products of the naturally occurring material. Following his findings, Wetzel[3], Bondi[4], Fischer and Skita[5], and Anderlini[6], studied the removal of sericin from silk and concluded that sericin in raw silk exists in more than one modification, although good experimental evidence to substantiate such a conclusion was lacking. In the above-mentioned investigations, different procedures for the preparation of the sericin solutions were employed, and little analytical work was done to characterize the protein fractions which were obtained. As a consequence, widely different results were reported by the different investigators. For example, Bondi found two fractions in a solution of sericin obtained by boiling silk in water, while Anderlini was able to separate three fractions after a prolonged extraction of raw silk with water at 50° to 60° C.

*Research Associates at the National Bureau of Standards representing the Textile Foundation, Inc.

More recently Shelton and Johnson[7] isolated two fractions from sericin solutions which have been obtained by autoclaving raw silk in water at temperatures of about 115° C. They concluded that raw silk sericin contains at least two proteins, one of which is soluble and the other insoluble in cold water. Subsequent investigators using the autoclave to remove the sericin appeared to substantiate these findings, and also attempted to define the properties of the isolated fractions. Mosher[8] stated that both fractions are very much alike chemically, but possess different physical properties, especially with respect to solubility. He further noted that the insoluble fraction was converted into a soluble one by boiling in aqueous solution, the conversion being greatly accelerated by increasing the acidity, alkalinity, or temperature of the solutions. Although he concluded that sericin is composed of three distinct fractions, his results could be interpreted to mean that sericin does not exist as a mixture of proteins in raw silk, and that these fractions are decomposition products formed during the process of removal of the sericin from the fibers.

In contrast to some of the conclusions of Mosher, Kaneko[9], and Ito and Komori[10] found the different sericin fractions to be different chemically. Their results were based on determinations of the nitrogen distribution and the tyrosine contents of the isolated fractions. However, disagreements are found even between the data of these investigators. For example, Kaneko found that the soluble fraction is especially rich in arginine nitrogen, whereas Ito and Komori found a greater proportion of this nitrogen in the insoluble portion.

From consideration of the previous investigations, it became evident that no satisfactory conclusion concerning the existence of several fractions of the sericin of raw silk could be reached. In the present investigation an attempt was made to throw further light on the question by making a more extensive study of sericin and of the fractions obtained from it.

II. EXPERIMENTAL PROCEDURE

1. Materials and Methods

Samples of white Japanese silk which had received no previous treatment other than that used in the reeling process were used in this work. The naturally occurring waxes were removed by cold extractions for 24 hours each with alcohol and ether. Analyses of the dewaxed fiber gave the values shown in Table 1. The data for sericin were calculated from the analytical data for the dewaxed silk and fibroin and from the determined sericin content.

Total nitrogen was determined by the micro-Kjeldahl method, and tyrosine by Lugg's method[11], after an alkaline hydrolysis. The amino-nitrogen content of the fibrous and of the insoluble proteins was determined by the method of Rutherford, Harris, and Smith[12]. The method of Van Slyke[13] was used for the determination of the amino-nitrogen content of sericin solutions. Carbohydrate and amino sugars were estimated by the methods outlined by Sorensen[14, 15].

2. Preparation of Sericin Solutions

Most of the sericin solutions used in this work were prepared by an autoclaving method similar to that described by other investigators[7, 8, 10]. The raw silk was placed in a beaker of water at about 100° C. in the autoclave, the ratio of fiber to water being 1 to 50. Steam was passed into the autoclave until a temperature of 114°-115° C. was reached. Approximately 5 minutes was required for this operation. The temperature was then maintained by addition of more steam for the duration of the treatment. The silk was removed from the solution, squeezed, and immediately rinsed in one 500-ml. portion of water at 90° C. As much liquid as possible was squeezed from the silk and combined with the rinse solution and the solution obtained after autoclaving. The combined solutions were then rapidly cooled to room temperature in a water bath.

3. Fractionation of the Sericin

In earlier work, the fractionation of the sericin in solution was accomplished by the use of alcohol or ammonium sulfate, but in more recent work, most investigators have preferred to use different buffer solutions. It was found necessary, however, to redetermine the pH for maximum precipitation as the values reported in the literature[8, 10] vary from pH 3.6 to 4.1. A preliminary experiment was made on a solution of sericin, prepared by a 30-minute treatment in the autoclave. The solution was brought to room temperature and aliquots of it were immediately adjusted to definite pH values in the range from 3.5 to 4.3 with acetate buffers of constant ionic strength (0.02 *M*). After 15 hours, the precipitated protein was centrifuged off, and the total nitrogen content (a measure of the protein remaining in solution) and the pH of the supernatant liquid were determined. A considerable portion of

TABLE 1

Total and amino-nitrogen, tyrosine, carbohydrate, and amino-sugar contents of the dewaxed silk, fibroin and sericin used in the present investigation. The data for sericin were calculated from the analytical data on dewaxed silk and fibroin and from determined sericin content.

Material	*Total nitrogen*	*Amino nitrogen**	*Tyrosine*	*Carbohydrate (as glucose)*	*Amino sugars (as glucosamine)*	*Sericin content*
	%	%	%	%	%	%
Dewaxed silk	18.29	0.14	10.9	0.67	0.80	23.7
Fibroin	18.73	.09	12.3	0.56	0.30	...
Sericin	16.92	.30	6.3	1.0	2.4	...

*Determined by method of Rutherford, Harris, and Smith[12].

the protein was precipitated in the pH range used, but maximum precipitation appeared to occur at pH 4.0. In all subsequent fractionation experiments, the solutions were adjusted to this pH and allowed to remain in a refrigerator overnight before removal of the insoluble protein.

The fraction which is insoluble at pH 4 was separated from the remainder of the solution with a centrifuge. The precipitate was thoroughly washed with fresh portions of the acetate buffer, then with alcohol and with ether, and finally dried for 4 hours in a vacuum oven at 50° C.

The acetate washings were added to the solution remaining after centrifuging and the whole was evaporated to a small volume by passing a stream of air over it at room temperature. The protein in the concentrate was precipitated by addition of the solution to a sufficient volume of alcohol (95 per cent) at about 0° C., to make the final concentration of alcohol 75 per cent. The precipitate was separated from the solution with a centrifuge, washed with alcohol and with ether, and dried in the vacuum oven for 4 hours at 50° C.

The solution remaining after the separation of the protein which was insoluble in 75 per cent alcohol was combined with the alcohol and ether washings from both sericin fractions, evaporated to dryness on the steam bath, and the weight of the residue determined. The solid material was dissolved in a small amount of water, the solution diluted to 25 ml., and suitable aliquots were taken for nitrogen, tyrosine, ad carbohydrate determinations.

4. Designation of the Sericin Fractions

The authors do not intend to perpetuate, in future papers, the use of the following terms for the designations of the sericin fractions. These terms, which were adopted by previous investigators, are used in this paper merely for convenience and to avoid further confusion. Sericin B is the fraction of the protein which is insoluble at pH 4. The fraction which is soluble at pH 4 but insoluble in a 75 per cent solution of alcohol is called sericin A. In the present investigation, a small fraction soluble in 75 per cent solution of alcohol was also found. For convenience, this material is referred to as sericin D, although in a series arranged in descending order with regard to solubility, it should precede sericin A. The existence of another fraction, sericin C, has been reported and described by Mosher[8] as extremely insoluble.

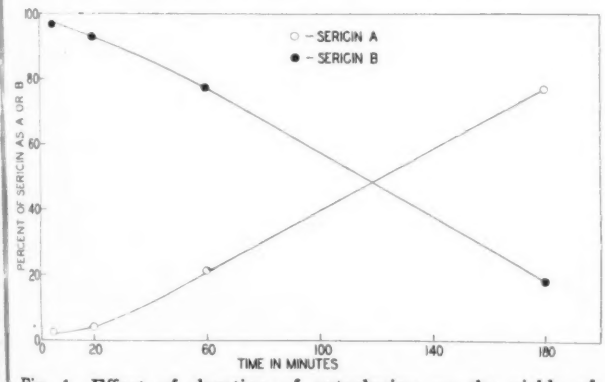


Fig. 1—Effect of duration of autoclaving on the yields of sericin A and B.

III. RESULTS AND DISCUSSION

The effects on dewaxed silk of varying the duration of the autoclave treatment are shown in Table 2 and Figure 1. About 80 per cent of the total sericin of the silk is removed in as little time as 20 minutes; practically complete removal is accomplished in approximately one hour. The yields of sericins A and B are seen to vary considerably with the duration of autoclaving. Of the total sericin removed during treatment of dewaxed silk for 5 minutes, more than 97 per cent was in the form of sericin B. The yield of this fraction decreased, however, as the duration of the autoclave treatment was increased until, after 3 hours, only 18.7 per cent of the total sericin was recovered in this form. On the other hand, the very low yield of 2.7 per cent of sericin A, obtained during the 5-minute treatment, was increased to 77.4 per cent by 3 hours in the autoclave. Only a small amount of sericin D was present. As is shown in the last column, practically all of the sericin in solution was accounted for.

The data clearly show that sericin A is a decomposition product of the naturally occurring sericin, and is formed during the autoclave treatment. If, however, fraction A were present in the native raw silk, it would be expected that it would be more rapidly removed, because of its high solubility. Actually, the sericin samples obtained in the shortest time of autoclaving (5 to 20 minutes) were practically entirely in the form of sericin B.

Further evidence supporting the conclusion that the fractions of sericin result from decomposition produced during autoclaving of the fibers is found in the analytical data of the different fractions as shown in Table 3. *The data show that sericins A and B as obtained under these conditions are not definite chemical entities but are sub-*

TABLE 2

Effect of duration of autoclaving on the yields of Sericin A, B and D.

Duration of Autoclaving	*Loss in wt. of dewaxed silk*	*Sericin B*	*Sericin A*	*Sericin D*	*Total extracted sericin accounted for*
min.	%	%	%	%	%
5	12.6	97.1	2.7	Trace	99.8
20	18.9	93.3	3.7	1.1	98.1
60	21.1	77.5	21.2	1.3	100.0
180	22.9	18.7	77.4	3.8	99.9

TABLE 3

Nitrogen and tyrosine contents of the sericin fractions obtained from dewaxed silk during autoclaving for different lengths of time at 115° C.

Duration of autoclaving	Sericin B				Sericin A			
	Yield	Total nitrogen	Tyrosine	Amino nitrogen	Yield	Total nitrogen	Tyrosine	Amino nitrogen
min.	%	%	%	%	%	%	%	%
5	97.1	16.87	6.2	0.32	2.7	13.94	Trace	...
20	93.3	17.00	6.5	...	3.7	15.68	2.5	...
60	77.5	17.23	6.5	...	21.2	16.44	5.1	...
180	18.7	16.44	5.4	0.45	77.4	16.67	6.5	0.49

TABLE 4

Effect of the duration of the autoclave treatment on the yield of sericin D.

Duration of Autoclave Treatment min.	Yield* of Sericin D mg.	Carbohydrate (as glucose) mg.	Amino sugar (as glucosamine) mg.
20	102	4.7	4.0
60	134	6.4	6.1
180	432	7.4	6.9

*Yield from 50 grams of dewaxed silk.

stances whose chemical compositions vary with the length of the autoclave treatment. A comparison of these data with the calculated total and amino-nitrogen, and tyrosine contents of sericin in dewaxed silk (Table 1) indicates that the sericin B fraction, obtained from silk during autoclaving for only 5 minutes, is probably very similar to the undegraded sericin. This similarity and the fact that more than 97 per cent of the sericin removed in this time is sericin B strongly suggest that all of the sericin in raw silk is present in one form.

Since the bulk of the sericin is removed in a relatively short time, and practically entirely in the form of sericin B, the increasing yields of sericin A must result principally from the decomposition of the sericin B after the latter has been removed from the silk. This decomposition appears to proceed fairly rapidly (Figure 1).

The increase in the yield of the very soluble fraction, sericin D, with increased time of autoclaving, as shown in Table 4, is indicative of even more extreme decomposition of the sericin. The chief interest in this fraction is found in its relatively high carbohydrate and amino-sugar contents. The samples obtained after 20 minutes contain about three times as much of these substances as the original sericin. It should be noted, however, that although there is a four-fold increase in yield of sericin D when the duration of the autoclave treatment is extended from 20 to 180 minutes, there is only a comparatively small increase in the total yields of amino sugar and carbohydrate. In other words, the first of these very soluble decomposition products is relatively rich in these substances, but the subsequent fractions of the sericin contain appreciably lower amounts.

The data in Table 3 also show that the conversion of sericin B to A is accompanied by an increase in amino-

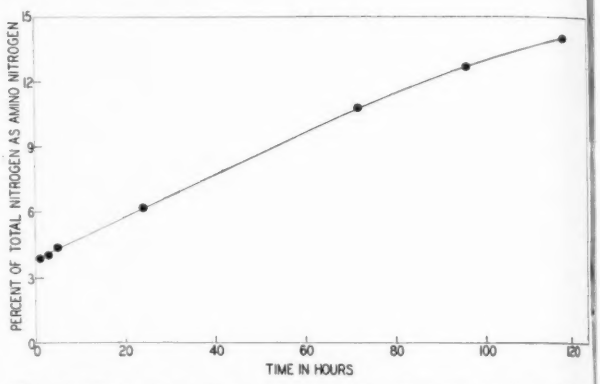


Fig. 2—Rate of increase of the amino-nitrogen content of a sericin solution during prolonged treatment at 100° C.

nitrogen content, sufficient to account for an appreciable amount of hydrolysis. Additional evidence that hydrolytic decomposition occurs during treatment of sericin with boiling water was obtained in the following experiment. A sample of dewaxed silk was placed in boiling water and aliquots of the resulting sericin solution were removed at different time intervals for the determination of total and amino nitrogen. The results are presented in Figure 2, and show that hydrolysis of the sericin proceeds at an appreciable and fairly constant rate.

No attempt has been made to isolate the sericin C fraction because, as shown above, none of the isolated fractions has any particular significance as regards the sericin as it exists in the raw silk.

IV. REFERENCES

[1]"La Dissolution du Vernis de Soie," Rigaut de Saint Quentin (1784).
[2]Cramer, J. prakt. Chem. *96*, 76, (1865).
[3]Wetzel, Z. physiol. Chem. *26*, 535 (1898).
[4]Bondi, ibid. *34*, 481 (1901).
[5]Fischer and Skita, ibid. *35*, 221 (1902).
[6]Anderlini, Chem. Zentr, (1887), II, 941; (1898), I, 795.
[7]Shelton and Johnson, J. Am. Chem. Soc. *47*, 412 (1925).
[8]Mosher, Am. Dyestuff Reptr. *21*, 341 (1932); Am. Silk and Rayon J. *53*, 43 (1934).
[9]Kaneko, J. Agr. Chem. Soc. Japan *9*, 45 (1933).
[10]Ito and Komori, Bull. Agr. Chem. Soc. Japan *13*, 115 (1937); *15*, 50 (1939).
[11]Lugg, Biochem. J. *31*, 1422 (1937); *32*, 775 (1938).
[12]Rutherford, Harris and Smith, J. Research NBS *19*, 467 (1937); RP1038.
[13]Van Slyke, J. Biol. Chem. *9*, 185 (1911); *12*, 275 (1912).
[14]Sorensen and Haugaard, Compt. rend. trav. lab. Carlsberg, Ser. chim. *19*, 1 (1933).
[15]Sorensen, ibid. *22*, 487 (1938).

Some Thoughts on the

Scientific Approach to Textile Problems*

ALBERT C. WALKER**

HUMAN progress is necessarily the result of experiment. The present industrial area, dating back approximately 150 years, differs to an important degree from previous history largely in the application of scientific methods of approach to the solution of problems, particularly in industry. The basic principle upon which these methods rest is experimentation. Much of our knowledge of materials and methods of experimentation is contained in quantitative data, the results of measurements made in the laboratory and factory. Since it is not possible, even with the utmost refinements in manufacturing processes, to make any two things exactly alike, it is important to have tests with which to measure the variations in the product. But before it is possible to characterize a product it is essential to determine the reproducibility of the method used to test the product.

Statistical procedures which have been developed within recent years are an important form of scientific approach in controlling the causes of variation not only in a manufactured product but also in gauging the test method itself. It should be emphasized that the first step in analyzing data is to see if the test method is capable of giving reproducible results, that is to determine if the results exhibit statistical control. Once this has been demonstrated it is possible to find out if the product is manufactured under technical control or whether some predominant cause of variation exists which may be found and corrected.

Data secured on a uniform product, with a test which has been demonstrated to be controlled in the above sense, can be used to predict the future quality of a product with much greater certainty than would otherwise be the case.

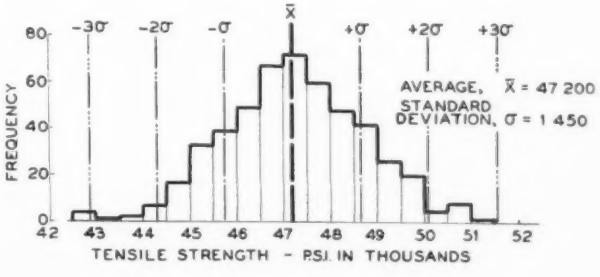
Furthermore, it is believed that a great deal may be accomplished in setting requirements for quality of manufactured materials by the intelligent application of some of the simpler statistical methods to the results secured from tests made on industrial products.[1] Efficient use of such statistical methods can result in important savings in inspection expense, since it can be shown that a small number of tests taken in a time sequence during manufacture may be tabulated in such a way as to reveal much more about the quality of the product than can a much larger number of tests made on only a single day's output. Since a statistically controlled type of test is essential before we can secure certain evidence on the control of a manufacturing process, it may make for clarity in this discussion to illustrate how experiments may be conducted so as to insure this condition.

The following example is taken from data secured in connection with the development of a baking test at elevated temperatures to determine the quality of cable paper and its resistance to deterioration. Since the primary object of the experimental work in this case was to establish uniform baking conditions, every effort was made to minimize the effects of variables aside from the baking conditions themselves. To this end a good quality of paper was selected in such a manner as to reduce to a minimum the variations in the paper. In addition, all tests were made by a single operator, in a controlled humidity room, on samples adequately conditioned after baking. After the preliminary investigation had indicated that the method might be satisfactory, tests were made by two operators in different laboratories, using baking ovens of similar construction, and these tests were made on selected samples from the same batch of paper.

If we were to tabulate the numerical values for a large batch of test specimens made under essentially the same conditions, we might expect to find them distributed somewhat in the manner of Figure 1. Statistically, the

Fig. 1

A TYPICAL FREQUENCY DISTRIBUTION



*Presented at meeting, American Association of Textile Technologists, March 6, 1940.

**Member, Technical Staff, Bell Telephone Laboratories; Chairman, Administration Committee for Drying Research, United States Institute for Textile Research.

[1]For a discussion of such statistical methods see W. A. Shewhart, "Economic Control of Quality of Manufactured Product," D. Van Nostrand Co., Inc., New York City, 1931, or A.S.T.M. Manual on Presentation of Data, Supplement B, Proceedings Am. Soc. Testing Materials, Vol. 35, Part 1 (1935).

two important measures of such a "frequency distribution" are:—

$\overline{X}$, the simple arithmetic mean of the individual values, and

σ, the standard deviation, being the root-mean-square deviation of the individual values from their average.

$\overline{X}$ indicates the central position of the values on the scales of measurement, and σ measures their speed around their average. Generally speaking, for frequency distributions having a fairly large number of observations, approximately two-thirds of the observations may be expected to fall within the range "average plus or minus the standard deviation ($\overline{X} \pm \sigma$)," and practically all within the range "average plus or minus three times the standard deviation $\overline{X} \pm 3\sigma$)."

Such a frequency distribution, however, gives much less information regarding the control of a product than a device developed by W. A. Shewhart[2] called a "control chart." This was designed for the practical purpose of discovering the causes of non-uniformity in quality, and it consists in plotting a uniform sequence of sub-group averages about a line representing the $\overline{X}$. If all of the sub-group averages fall between certain limits about this $\overline{X}$, these limits being determined by deviation values calculated from the sub-group data, then it can be said that the test gives controlled results.

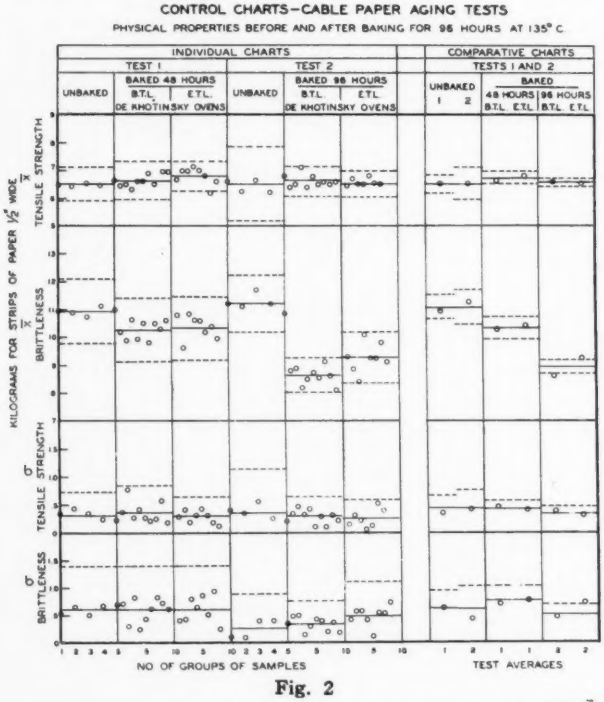


Fig. 2

Figure 2 shows a series of control charts on data taken from two different laboratories on the baking of cable paper. Two types of tests were used in securing data on the effect of baking, these tests being tensile strength and brittleness[2]. About 30 samples of paper were used in each test, and the results were separated into a sequence of groups of 4 samples each. The average of each group of 4 were then plotted as shown and the solid horizontal line in each graph represents the $\overline{X}$ for all samples in a group, while the dotted lines represent control limits for individual averages (statistically, $3\sigma \pm$, or three times sigma limits for the distribution of sample averages).

It will be seen from Figure 2 that all values for tests made in the two laboratories give satisfactory results as measured by this criterion. Some additional evidence of control is given by supplementary charts of σ variations, and by comparisons of all data from both laboratories, summarized as single points. These charts provide impressive evidence that the test conditions are such that adequate control may be secured in more than one laboratory with such a test.

Similar charts have been made on data obtained in the development of a method for measuring the quality of washed textiles used as electrical insulating material on wire. In this case the test conditions required exceedingly exact control, since a change of 1 per cent in relative humidity in the atmosphere in which the textile samples were equilibrated, while causing a variation of but 0.1 per cent to 0.2 per cent in moisture content, resulted in a change of 25 per cent in the electrical insulation resistance. Data secured on this test after it was perfected have been published by W. A. Shewhart[1]

This method of test is in use as an inspection procedure in the commercial preparation of washed textiles used in the telephone industry, and the data when plotted as daily averages on control charts similar to those in Figure 2, together with frequency distribution charts for the individual inspection tests each month, make it possible to check the process for undesirable variations in quality and to indicate limits within which the electrical quality of the material may be expected to fall. Thus it is possible to use daily inspection data as a means of setting requirements, since the data from the production tells its own story when treated properly on these relatively simple charts.

Since the principles above outlined are fundamental to the orderly conduct of any research project and are very helpful aids in improving manufacturing processes, it may be of interest to discuss briefly how they have been utilized in the program of research on the drying of textiles, now in progress at the National Bureau of Standards, sponsored by the United States Institute for Textile Research, and supported by contributions from the textile industry.

One of the serious problems in the drying of textiles is the removal of moisture from the interior of the material rapidly, yet without overdrying the surface and causing such effects as case-hardening. Obviously the higher the temperature at which the drying is carried out, the more rapidly the process may be completed, other things being equal, but at the same time this increased temperature results in a greater difference in moisture content between the inner and outer portions of the material. It has become increasingly evident within the past few years that

[2]Paper Trade Journal, Vol. 88, 56, 1929.

control of humidity of the air in contact with such drying material is quite important in maintaining uniform quality. In fact, within the past few years manufacturers of drying equipment have installed humidity recorders on dryers coupled to automatic dampers so that the air within the ovens may be kept at such a humidity that the exterior of the material is not excessively dried before the moisture content of the interior is reduced to a suitable value. Improvements such as these have undoubtedly contributed largely to the better quality of textiles. For example, it is said that advances made in the drying of rayon have produced a greatly superior product. Such improvements in quality have been reflected by an increase in world production of much more than 1000 per cent during the past 15 years.

Yet even with such modern equipment the time required for drying certain types of textiles, such as packaged cotton, still requires periods of from 12 to 20 hours, hardly in keeping with our modern streamlined procedures.

In planning the research work on drying it appeared to be important to first collect fundamental information on the amounts of moisture which could be retained in different commercial textiles when brought to equilibrium with definite relative humidity and temperature conditions, over as wide a range as possible. This information was for the purpose of providing limiting conditions within which commercial control might be more exactly maintained.

In considering ways and means of securing such fundamental data, use was made of the principle employed in the humidity equipment which has been developed in connection with the measurement of the electrical properties of textiles under controlled humidity and temperature conditions. Evidence had already been secured that this method could give controlled conditions of operation, from a statistical standpoint, therefore a similar apparatus was constructed, but capable of operating up to a temperature of 300° F.

The first year's work consisted primarily in determining equilibrium moisture content data for ten representative textiles, including cotton, silk, wool, and several types of rayon, over as wide a range of relative humidity as possible for each of several temperatures between 100° F. and possible with the limited available data in the literature, 300° F. The results of this work were checked where and they were found to be consistent with such data.

Another principle of analysis of experimental evidence is that an effort should be made to reduce the data to some form of linear relation so that it may be possible to interpolate experimental values at any point within the range investigated. A straight line relation is far more simple and useful for commercial purposes than is some form of curve, even though an equation is available for the curved function.

Therefore, we were gratified to find that the initial experimental data on moisture content vs. relative humidity for the series of temperatures investigated on a drying cycle could be expressed as a set of linear relations when either the log of moisture content, or the log of relative humidity was plotted against 1/T, where T was the absolute temperature. This greatly simplified further experimentation, for it was evident that only two or three different temperature conditions were necessary to completely characterize all of the experimental data in the range from 100° F. to 300° F.

Furthermore, these relations enabled us to work out applications of some fundamental thermo dynamic equations expressing these relations and to derive information of a much wider scope than had been expected when the work was planned. Of a more practical nature, is the fact that it is now possible to prepare tables of a rather complete nature giving specific values of moisture content for any temperature and humidity in the commercial range. These results are now being prepared for publication and will be available shortly.

Of what use is this in industry? Since it is increasingly evident that in drying textiles it is important to maintain some moisture in the atmosphere of the dryer, it is equally important to know what level of humidity at the drying temperature is economically desirable and most favorable to the finished condition of the textile. The above data do not, of course, give all the answers to such questions, but they provide a tool which the engineer may use to give greater certainty in deciding what conditions should be used in the factory to get the best, quickest and most economical results in drying.

The second year's work of the drying research program was devoted to some more practical problems, such as determining the effect of heat and humidity together upon some important physical and chemical properties of these textiles in the pure state. Contrary to what seems to be generally believed it was found that if the fiber was maintained in a moist atmosphere at a high temperature, the effect on both physical and chemical properties was markedly more harmful than if the material were exposed to the same temperature for the same time at a much lower humidity. Data on this work include the effect of temperature at various humidities on significant properties of the several types of textiles investigated.

Mr. J. G. Wiegerink, the Research Associate engaged in this drying research project, has just completed a series of tests on package drying of cotton with an experimental machine in which air may be forced through the textile wound on perforated tubes. The results include such variables as rate of air flow, temperature, humidity, and some estimates of relative economy under these different conditions. These results, which have not as yet been carefully analyzed, show some interesting possibilities regarding rate and unifomity of drying.

At present Mr. Wiegerink is investigating the effect of heat and humidity on textiles which have been subjected to certain well-recognized commercial treatments, such as sizing, bleaching and other treatments. This will amplify the work already completed on purified materials, and will provide a basis for comparing the effects of these treatments.

To summarize, the work of the project here outlined

illustrates how systematic investigation of a comparatively few factors may be of considerable importance in charting limiting conditions under which commercial processing may be carried out with safety and economy. In addition, valuable information is being secured regarding the effects of certain commercial treatments as affected by the common denominator of drying. It is, however, up to the trained technologist in industry to apply this information to his individual problem, utilizing statistically controlled methods of testing to set up more satisfactory criteria of quality of manufactured product. Furthermore, economies may be effected in the amount of time devoted to inspection tests, by use of these control charts, without impairing but rather enhancing the value of such tests.

In discussing the future possibilities of research in industry one observer expressed the opinion that in this century particularly, so many of the simpler tasks of research had been finished that the present research workers were left with the more difficult problems which require coordinated effort of a group for their solution. To illustrate his point he expressed the opinion that one would not expect to find any person inventing a mousetrap. Immediately another observer stated that at a recent inventors' convention, three new mousetraps were exhibited.

This illustration emphasizes the fact that even the simplest and most common industrial process which has been accepted as being economical and satisfactory may be studied by scientific methods to considerable profit. Whatever our advance in industry, it may pay to re-examine from time to time processes and products from the viewpoint of new theories, new data or new equipment, with the object of effecting improvements or economies.

Lecithin from Soy Bean

Its Uses in Industry, Especially in the Textile Industry

E. W. K. SCHWARZ*

LECITHIN is an important component of egg-yolk and is responsible for the softening effect of the latter, when applied on leather or on textiles. According to J. Schmidt it belongs to a group of organic compounds called: phosphatides, since it contains phosphorus. Phosphatides are related to the ordinary glycerides and are present in small quantities in fats, in the brain and muscle tissues of animals, in grain germ, also in certain vegetable fats. Chemically, phosphatides are mixed fatty acid-phosphoric acid esters of a polyvalent alcohol and an amino alcohol. Some of the most important representatives of the phosphatides are the lecithines, of which 70 different forms are theoretically possible. Today, the term "lecithin" is generally applied to the phosphatides made by solvent extraction of the soy bean. It is a compound of complicated constitution, which has been established by its products of decomposition. When treated with diluted acids or alkalies, lecithin decomposes into choline and a tri-ester of glycerin: di-stearyl phosphoric acid glycerin ester,

$$\begin{array}{l} CH_2 - OCO \cdot C_{17}H_{35} \\ | \\ CH - OCO \cdot C_{17}H_{35} \\ | \\ CH_2 - OPO(OH)_2 \end{array}$$

Therefore lecithin is the choline salt of this ester. However, other fatty acids (palmitic, oleic, linoleic and linolenic acid) have been found in soy bean phosphatides besides stearic acid. The general structural formula is thus:

$$\begin{array}{l} CH_2 - OCO - FA \\ | \\ CH - OCO - FA_1 \\ | \\ CH_2 - O - P(=O)(OH) - O - CH_2 - CH_2 - N\equiv(CH_3)_3 \end{array}$$

FA and FA_1 may be any one or two of the above fatty acids. As a matter of fact most of the lecithins are "mixed" compounds, i.e., they have two different fatty acids in the molecule. The phosphoric acid can also be linked to the center, or "beta" carbon atom of the glycerin radical, in which case we have a "beta lecithin." Another important modification occurs when the amino-compound, instead of the trimethyl derivative — "choline" — is the amino-ethanol derivative: colamin. Then we have cephalin, which is insoluble in alcohol, and which usually is present in phosphatides. Since the properties of the various phosphatides are practically alike, we do not have to make any distinction as to their industrial uses. These industrial uses are very many, and some of the industries using lecithin are:

USES

First place among the industries using lecithin are the food and chocolate industries. In baking cake and bread ¼ to 1 per cent of lecithin is added to the dry flour to catalyze nourishment of yeast.[1] The candy and chocolate industries use lecithin in very large amounts, it lowers the viscosity of the chocolate mass and allows great

(Continued on page 234)

*Consulting textile chemist.

PROCEEDINGS OF THE
American Association of Textile Chemists and Colorists

APRIL 29, 1940

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• CALENDAR • OF COMING EVENTS

Meeting, Mid-West Section, Schroeder Hotel, Milwaukee, Wisconsin, May 4, 1940. Speakers: Paul Logue, Phosphate Division, Monsanto Chemical Co., "Some Uses of Tetra Sodium Pyro Phosphate in the Textile Industry"; Norton Thomas, City Chemist and Bacteriologist, Milwaukee, Wis. "The Purification of Milwaukee's Water Supply."

Meeting, Southeastern Section, Ralston Hotel, Columbus, Ga., May 11, 1940. Speakers: J. W. Ivey, Mathieson Alkali Works, "Textone"; B. J. Kane, Fulton Bag and Cotton Mills, "Cotton Goes To Market."

Meeting, New York Section, Swiss Chalet, Rochelle Park, N. J., May 24, 1940.

Annual Outing, Philadelphia Section, Seaview Country Club, Absecon, N. J., June 15, 1940.

Outing, Piedmont Section, Ocean Forest Hotel, Myrtle Beach, S. C., June 21 and 22, 1940.

Annual Meeting and Convention, auspices New York Section, October 18th and 19th, 1940, Hotel Commodore, New York City.

Control in Spun Rayon

Piece Goods Processing*

PAUL J. CHOQUETTE**

The Scientific Method

THE general subject of control is linked up to what might be described as the "Scientific Method." Industrial organizations have demonstrated its value in production planning. Witness the development of a process from the laboratory scale through the pilot plant and into production. The textile industry has been fortunate in being able to draw upon the research of our chemical industries for new developments. In the application of this knowledge our most successful textile finishers have applied the scientific method in developing and controlling operations.

Fabric Design

It is my purpose to outline some of the control factors in the processing of spun rayon piece goods. Dr. F. Bonnet, in recent articles, has described very well the many possibilities of utilization of cut rayon staple in the design of interesting fabrics.[1, 2] Spun rayon in its various deniers from 1½ to 20 is being used for so many purposes that it is almost impossible to say that a certain denier is particularly used for any one single purpose, with the exception that as the denier of the rayon controls the size of the yarn which is spun it is almost a general rule that 1½ denier goes into the majority of light weight dress goods cloths utilizing fine yarns. There is a particular trend at the moment toward fabrics made of blends of spun viscose rayon and acetate rayon permitting the creation of interesting cross-dyes. The advent of the new staples nylon and Vinyon may also introduce new developments.

Semi-Works Control

The first step in control is the patching of the grey goods. The composition and types of fiber present, the type of sizing used must be determined. With this as a guide, a patch is boiled off by a method protecting all fibers concerned. Laboratory dyeings should follow interpreting the desired color effects and as a guide to plant practice. If there is still some doubt as to the best procedure to be followed a trial piece may be processed in the plant with shrinkage factors determined. Plant routine follows.

Plant Routine Control

William Cady, in a recent article, has described very well the general principles of spun rayon finishing.[3] Plant control starts from the first operation of desizing, for starch an amylitic enzyme T., 130° F., pH 5-6, minimum time of standing 2-4 hours; for gelatine a proteolitic enzyme or water. This operation may follow singeing when singeing is required. Spun rayon and worsted fabrics are usually dry singed if this is required to be followed by a setting operation.

Control of Setting Operations

The primary purpose of this operation is to remove the unbalanced condition of the fibers and thus prepare for subsequent operations with the avoidance of wrinkles and creases. Shrinkage measurements are a means of control. For certain fabrics, water or water plus a wetting out agent may be sufficient prior to scouring in swelling the fiber. All spun rayon may be causticized at concentrations from 3-8° Tw. as a means of swelling the fiber and equalizing dyeing and printing quality. Consideration must be given to the finished hand as a crisper finish may result. This treatment may be given on the standard crepe causticizing machine or by padding and batching followed by washing. Extreme care must be taken to avoid uneven concentration of caustic in spots as strains may result in subsequent dyeing. This treatment is said to be particularly helpful for goods which are to be naphtholated. With an increase in the worsted content of a fabric or for those very subject to creasing a crabbing operation may be required. This is the basic operation for setting worsted goods as fulling is for woolen. The cloth is passed through boiling water and is then set by quick cooling. The continuous open soaper may be used for this purpose — boiling water approximately 1 minute, followed by 1 box of cold water and batching. Shrinkage in width is a convenient means of control and may vary from 2-8 per cent. Jigg crabbing also may be used.

Scouring and Bleaching

Fabrics may be scoured in the kier, on the continuous open soaper, on the continuous crepe soaper, on the jiggs or in the dye kettles. In some cases scouring and dyeing may proceed in the same bath. Controls involve the avoidance of creases and rubs, measurements of width, concentration, temperature, and pH of baths. For all spun rayon, T. 180-190° F., pH 10-11; spun rayon and acetate rayon, T. 160-170° F., pH 8; spun rayon and wool, T. 130-140° F., pH 8.

Spun rayon, cotton and acetate rayon may be bleached with sodium hypochlorite at room temperatures, 1-2-3 g.p.l. of chlorine and a pH of 9-10. Bleaching is followed by an anti-chlor such as sodium bisulfite to remove the last traces

*Presented at meeting, New York Section, March 29, 1940.
**Chief Chemist, Cranston Print Works Co.

of chlorine. Sodium hypochlorite cannot be used if wool is present as yellowing will result.

Hydrogen peroxide may be used to bleached the above and also to bleach wool. The following control factors must be observed:

Spun rayon, T. 160-180° F., pH 10x6, buffer, with
6 lbs. sodium silicate

100 gallons

Spun rayon and acetate rayon, T. 140° F., pH 7x6, buffer, with
Disodium acid phosphate 10 lbs./100 gallons.
Spun rayon and wool, T. 130° F., pH 9x2 buffer, with
3 lbs. sodium silicate

Adjust pH with ammonia.

100 gallons

Control titrations should be made with standard potassium permanganate and sulfuric acids.

For wool later to be dyed, sodium pyrophosphate should be substituted for silicate.

It is important that goods be thoroughly washed after bleaching and if required, an acid salt used to adjust pH to 6x5 particularly for whites. On the alkaline side yellowing will be accentuated with overdrying.

Dyeing

Laboratory formulation can be of genuine assistance to the dyehouse, particularly in the development of mixed fiber fabrics. In the plant the use of sample kettles multiplies the output. Patch technique is very important and records should be kept for future reference. To illustrate, it is known that a certain fabric is to be given a resin finish which has an influence upon the shade which must be allowed for in the dyeing.

All spun rayon may be dyed with all of the usual colors. For light shades fast to light directs are preferred. The control factors here are level dyeing properties and resistance to changes on finishing, in particular, fastness to light with the resin finishes. Temperature of application is 120-190° F.

For dark shades the direct diazotized and developed or direct and aftertreated are preferred. For the developed shades the stability of the diazotization must be controlled. The diazonium salts are unstable in presence of direct sunlight or even high concentrations of reflected light and must be protected from same. Copper is known to catalyze the decomposition of nitrous acid and care must be taken that goods do not stop over a brass reel during diazotization for undeveloped spots may result. In the continuous method of diazotizing and developing the concentration of the diazotizing bath must be maintained constant by titration with potassium permanganate and the alkalinity of the developing bath at a pH of 10.5-11.5.

In the handling of the direct aftertreated with copper sulfate to improve fastness to light and direct aftertreated with formaldehyde to improve fastness to washing care must be taken to note the effect of treatment upon the shade.

Excellent results may be obtained with naphthols on spun rayon, producing very brilliant shades. The control factor here is not to overdry and may be measured by an absorbency capillarity test.

Spun rayon may be dyed with vat colors by the continuous method or pigment pad. An interesting example of control has been the successful dyeing of spun rayon and wool mixtures with vat colors by the pigment pad method. This process has been based upon the careful selection of dyes which reduce the most readily at the lowest temperatures. Padding takes place in the presence of wetting out agent followed by developing in a bath whose pH (alkalinity) has been reduced by substituting for the usual caustic soda a mixture of trisodium phosphate and a protective colloid for the wool together with glucose and sodium hydrosulfite.

Spun Rayon and Wool—Solid Shades

Spun rayon and wool mixtures are dyed by the usual technique required for union dyeing. Precautions are to avoid the use of mineral acids which might tender the rayon and to see that the temperature 190-200° F. and time are sufficient to fix the wool dyeing.

Single Bath

For solid shades dyeing may proceed in a single bath with fast to light direct colors and neutral dyeing wool colors or with fast to light direct colors withstanding metachroming and metachrome dyes. Control factor, temperature 195° F, 1 hour, cooling ½ hour. To improve fastness to washing, direct aftertreated with formaldehyde colors may be used by aftertreating in a fresh bath with formaldehyde.

Two Bath Method

When it is desired to use developed colors on the rayon, one can dye the rayon with fast to washing colors deeper than the wool and then balance off the wool with wool dyes in a fresh bath. Control factor for the rayon, T. 140° F, ammonia and Katanol to resist the wool. Normal precautions for diazotizing and developing. Wool colors in a fresh bath, Temperature 120-200° F, for 1 hour, at this point exhausting with acetic or formic acids as required. For improved fastness to washing on the wool, metachrome or top chrome dyes may be used.

Cross Dyes—Wool Dark—Rayon Light

To dye the wool a heavy shade contrasting with a lighter shade on the rayon the wool is first dyed with selected acid or top chrome colors leaving the rayon clean. Control factors are to maintain temperature at full heat, 200° F, using only the required amount of dye to produce the shade when exhausted with formic acid. If required the rayon may be given a warm rinse prior to chroming. Chroming should be thorough and at full heat. The rayon is then brought to shade in a fresh bath at 160° F.

Rayon Dyed—Wool White

Selected direct, direct aftertreated, diazotized and developed colors are used for this purpose. Control T. 140°

F, bath alkaline with ammonia and Katanol wool resist. In the case of the diazotized colors it is difficult to avoid a slight yellowing of the wool by nitrous acid present. This is reduced by maintaining the concentration of nitrous acid at a minimum. Urea may be used as an assistant.

Spun Rayon and Acetate Rayon

This class of fabric is very well suited for cross dyes. Selected direct, direct aftertreated, diazotized and developed dyes are used to leave the acetate rayon white. Control, T. 160-170° F, and freedom from alkali to saponify the acetate. Cross dyes are normally dyed in the same bath with selected colors.

For certain shades on acetate rayon to leave the rayon clean it may be necessary to clean the rayon in a fresh sodium hydrosulfite bath followed by a mild peroxide bleach or sodium hypochlorite. This is best controlled by patching to determine the best concentrations with a minimum effect on shade.

Printing

Spun rayon may be printed with the usual rayon colors. As it is usually not pigmented, full advantage may be taken of methods producing maximum color yield consistent with a soft hand. The following control factors are important for smooth operation.

Print Thickening

The ideal print thickening must possess the proper flow characteristics[4] and maintain these with time of standing.[5] As a control, the finished colors should be checked by the same methods. For vat colors the newer developments have taken into account the relationship between solids content, print characteristic and color yield. For the stabilized naphthols (Rapidogens, Pharmasols, Diagens) and solubilized vats (Algosols, Indigosols) the freedom from excessive amounts of reducing matter and stability to alkali and oxidizing agents must be determined. Starch in its varying degrees and types of conversion is still the most common medium though the natural gums and synthetic resins find their place in improving penetration and softness of hand. The preparation of the resin emulsions must be carefully controlled, particle size being influenced by temperature, concentration and rates of addition.

Printing Assistants

In the printing of Algosols or Indigosols on spun rayon improved results are obtained with the use of solvents of the glycol types which assist penetration and swelling of the fiber. Poor penetration may result in decreased fastness to washing.

Print Development

In the ageing of vat colors the usual precautions in controlling steam conditions must be observed. A qualitative test for the steam conditions may be obtained by noting the loss in weight of a water saturated patch when passed through the ager and comparing to a standard. The fatty alcohols and fatty acid esters, because of their excellent rinsability and resistance to lime and acids, are finding increasing application in washing and printing. Spun rayons are particularly sensitive to odor formation from soap or fatty acid contamination.

For the Algosols or Indigosols it is important that complete development of color be obtained before passing into the rope form otherwise a colorless mark off may be obtained which may persist through the finishing operations to be developed later when exposed to light. This may be controlled by patching after acid ageing and aftertreating with chrome and sulfuric acid and noting any increase in shade. If required, the goods should be aftertreated in the open, the strength of the bath to depend upon individual plant conditions. The effect of light in developing a mark off of undeveloped color may be simulated by pressing a wet print against a white cloth, drying and exposing in the Fade-Ometer—the color will be developed, or the patch after drying may be given a chrome sulfuric aftertreatment to bring up the color.

Pigment Prints

The new pigment colors fixed with resin binders find numerous applications particularly in the production of bright peg colors. Fastness to crocking has been greatly improved by the new methods of pigment dispersion. Control tests must be made on the recommended curing (drying or drying plus acid ageing) and the ratio of binder to pigment to ensure maintenance of standards.

Direct and Acid Colors

Brilliant shades have recently been produced by the use of acid and direct colors on spun rayon. The success of this process depends upon the proper selection of dyestuff and the utilization of urea, trisodium phosphate and other solvents to increase solubility and aid fixation. The best results are obtained by steaming in the cottage steamer but when not available a 15-minute ageing in the vat ager can be used. Control tests include a water bleeding test made by placing over the prints a piece of wet white rayon and letting same dry out.

Extraction and Drying

It is important that the uniformity of extraction be controlled whether it be by vacuum or by basket prior to drying. Variation at this point may cause over drying in spots and result in yellowing of white particularly if any sizing is present or if the pH is on the alkaline side. Under conditions where dry heat may develop a temperature of 200-230° F. is preferable for whites instead of the available 300-310° F. Extreme care must be taken in drying spun rayon and wool whites—satisfactory results have been obtained on the tenter frame at 180° F. when this type of drying was required.

Wherever possible drying in the relaxed state (no tension) should be employed. With improved control of moisture content as delivered to the dryer full advantage may be taken of the rapid drying obtained with the air lay type of drier.

Finishing

The extent and nature of the finishing operations de-

pend upon the type of fabric and finish required. To simulate the woolen hand, we now have the crimped acetate rayon staple. The woolen finishing operations of gigging or napping may be employed and, if required, decatizing. Button breaking and lapped calendering are useful in modifying hand.

Finishing materials are available to produce any desired hand from the soft wool hand to the full suiting finish. Extreme care must be taken in selecting and blending these materials to produce the desired hand. The following control factors must be determined.

1. *Freedom from rancidity due to oxidation, yellowing of whites.* These properties may be determined by accelerated laboratory ageing tests as described by R. A. Pingree.[6] Materials in this class would be the sulfonated oils such as olive, the sulfated fatty alcohols and the cationic softeners.

2. *Stability to the temperatures of drying.* It is important to note the temperature limits to which a finish may be subjected in the light of the higher temperatures used in the modern driers. As a general rule it may be said that for starch products the yellowing will increase with the degree of conversion and a pH on the alkaline side. It will be a minimum at a pH of 6-7. This pH in turn may be influenced by the pH of the added softener which preferably should be at pH of 6-7.

3. *Mutual compatibility.* In the light of more recent developments our finishing materials may be divided into cationic and anionic. It is important that these two classes be not mixed in the same bath. To illustrate, the substantivity of a cationic softener will be impaired by the presence of alkaline agents in the goods. On the other hand they may be blended with resins and starches which maintain a proper ionization or are neutral. Other resin emulsions may only be blended with the usual sulfonated oil or wax emulsions which are not dependent upon substantivity for their effect. (Anionic)

4. *Development or cure of resins.* Success in the utilization of the resin finishes depends a great deal upon the control of fixation. In many cases drying alone is sufficient, this being true of the more highly polymerized types and of the emulsion dispersions. For the anti-crease finish no successful substitute has as yet been found for the urea-formaldehyde type. In combination with a cationic softener or suitable body builders the hand may be varied as desired. The control factors include: avoidance of overdrying before curing, pH maintenance during cure (4.5-5.0), correct cure, a function of time and temperature, at 300° F.—3 minutes, correct washing to bring the pH to 6.5-7.0, the avoidance of overdrying after washing. With this control satisfactory results have been obtained.

5. *Evaluation of fastness to washing.* With the advent of the new substantive and resin finishes, evaluation of fastness to washing becomes of increasing importance. In many cases the effects are produced with such small quantities of fixed material that the significance of the amount lost can only be evaluated in terms of the change in hand. With increasing amounts of fixed material, quantitative data on the percentage lost may be more significant. This would apply to finishes such as anti-crease where the resistance to creasing may be correlated with resin content. The development of methods for evaluation of finishing treatments as outlined by Professor Schwartz in his work with the "Drapeometer" should assist in the standardization of these tests.[7]

References

[1]Bonnet, F. "Spun Rayon" A.D.R. Vol. 27 No. 16 P.441.
[2]Bonnet, F. "Vinyon—A New Textile Fiber" A.D.R. Vol. 29 No. 5 P.116.
[3]Cady, W. H. "Processing of Spun Rayon Mixtures" A.D.R. Vol. 27 No. 23 P.635.
[4]Glarum, S. N. "The Measurable Properties of Vat Printing Pastes and Thickeners" A.D.R. Vol. 26 No. 5 P.124.
[5]Truax, D. E. "The Stability of Printing Pastes" A.D.R. Vol. 28 No. 10 P.262.
[6]Pingree, R. A. "Oxidation of Finishing Oils" A.D.R. Vol. 26 No. 14 P.379.
[7]Jacob Katz. "Surface Cation Active Compounds in the Textile Industry" A.D.R. Vol. 28 No. 23 P.671.
[8]H. H. Mosher. "Permanent Softening Agents" A.D.R. Vol. 28 No. 18 P.484.
[9]Schwarz, E. R. "Evaluation of Finishing Treatments" Textile Research, Vol. 9 No. 6. A.D.R. Vol. 28 No. 24 P.688; A.D.R. Vol. 28 No. 16 P417.

DISCUSSION

Mr. Dogin: You mentioned at the very beginning the selection of certain fast direct colors for light shades, with a view to the effects of the finishes. What effects have the finishes on these certain direct colors?

Mr. Choquette: The fastness to light of certain of the direct colors is impaired by the urea formaldehyde resins in particular, so that by selecting the colors after evaluation of their fastness to light you can select those colors which will withstand the resin finish.

Mr. Borghetty: In connection with the causticizing treatment that was recommended at the beginning of the speech, would you kindly indicate whether the period of time of ten seconds would be sufficient? In other words, could it be done in continuous operation?

Mr. Choquette: The experience with respect to causticizing seems to vary a great deal from plant to plant. In my own case I have found that treatments which will give you a little more time than five to ten seconds normally are necessary. But many plants do handle the spun rayons under conditions where the causticizing treatment will take about ten seconds. However, the effect which you are trying to obtain would have some influence upon that length of time.

Mr. Borghetty: Well, couldn't the increase in temperature be used in order to compensate for the short time?

Mr. Choquette: In that connection, someone may be able to offer a new idea. I notice, in reading the literature, it is claimed that caustic treatments aid in washing out impurities which are present in the rayon. We know that the sizing may be in the form of starch or gelatin. For

the concentrations used, I would question whether caustic would have an effect upon gelatin.

Undoubtedly it would have a swelling action upon starch which may be beneficial. This action would be accelerated with an increase in temperature.

REPORT, NORTH CAROLINA STATE COLLEGE STUDENT CHAPTER

THE Student Chapter had as their guest speaker recently, "Pat" Gaskins of Phipps & Bird Company, who gave lectures to several classes on the use of the Coleman Electrometer.

The lectures were illustrated by actual use of the equipment to show the ease of obtaining pH readings with colored solutions made up from various classes of dyes with addition of acid or alkali.

Respectfully submitted,

WILLIAM S. PEARSON, *Secretary.*

MEETING, PHILADELPHIA SECTION

THE last meeting of the Philadelphia Section was held at the Penn Athletic Club on Friday evening, March 8, 1940.

We had as our speaker Dr. Robert E. Rose, Director of the Technical Laboratory of the Du Pont Co., whose subject was "1914-1939"—a contrast in National Independence. Attendance—147.

Respectfully submitted,

J. P. CONAWAY, *Secretary.*

MEMBERSHIP APPLICATIONS

Associate

Howard M. Collier—Manager, Griffin Knitting Mills, Griffin, Ga. Sponsors: L. L. Baker, P. N. Collier.

Morris H. Cone—General Manager, Hartford Woolen Co., Hartford, Vt.

Foster L. Jones—Agent, National Oil Products Co., Cedartown, Ga. Sponsors: C. Mueller, A. Fisher, Jr.

Robert Mulligan—Treas. and Gen. Manager, J. U. Starkweather Co., Providence, R. I.

Frank George Roux—Salesman, Sandoz Chemical Works, Chicago, Ill. Sponsors: E. Meili, J. C. Walker.

John Edward Whetstone—Salesman, J. U. Starkweather Co., Providence, R. I.

Student

T. F. Parks—North Carolina State College. Sponsor: A. H. Grimshaw.

L. J. Winiarski—North Carolina State College. Sponsor: A. H. Grimshaw.

F. J. Szymosek—Lowell Textile Institute. Sponsor: L. A. Olney.

UNEMPLOYMENT REGISTER

Members of this association, who are without employment, should forward to the secretary a statement as to their qualifications and experience. This information will subsequently appear on these pages with an identifying key number. Employers are also requested to file with the American Dyestuff Reporter any vacancies which may occur in their business.—H. C. Chapin, Secretary, Lowell Textile Institute, Lowell, Mass.

NOTICE TO EMPLOYERS

Complete personal histories and employment records of the following applicants are on file at the office of the American Dyestuff Reporter.

Key: A—Laboratory and research; B—Dyeing or printing; C—Finishing; D—Sales; E—Instruction; F—Executive.

NOTE: PERSONS WHO HAVE OBTAINED EMPLOYMENT SHOULD NOTIFY THE SECRETARY OR THE AMERICAN DYESTUFF REPORTER AT ONCE.

A-B-7

Education—Evening school in textile dyeing and chemistry.

Experience—Dyehouse laboratory for 2 years. Foreman dyer and finisher on hosiery for 9 years. Experience on ribbons also vat dyes on rayon and silk skeins. 2 years assistant to superintendent. Desires position either in demonstrating and sales or dyer; New York Viciniy. Age 33; married.

A-B-8

Education—Graduate Chemist.

Experience—Print superintendent, colorist; eleven years' experience in all types of fabrics, specializing on rayon; 8 years' dyestuff laboratory and demonstrating. Excellent references; age 37; married.

A-B-9

Education—Bradford Durfee Textile School, 1918, chemistry and dyeing course.

Experience—Dye application, textile and color chemist; good general factory, laboratory and office experience; accustomed to assuming responsibility; handled all types of help; purchased chemicals, dyes, etc.; executive ability; good personality.

Age 42; American, married; will go anywhere for interesting work; references.

A-B-10

Education—1 year of textile chemistry, day course, Philadelphia Textile School; also business course.

Experience—3 years as apprentice in weaving mill in Germany, office and stock room, general clerical work, practice in all departments of cotton manufacture, dyeing, bleaching and finishing of cotton-rayon mixtures, piece and package processing; several mos. in laboratory of German dyestuff manufacturer, dyestuffs and assistants and their application, vat and naphthol dyeing.

Age 20; will go anywhere in U. S.

A-B-11

Education: Graduate chemist. Correspond and converse German, some French.

Experience: 3 years dyer; 4 years dyestuff testing, trouble-shooting, purchasing; 4 years demonstrating, consulting, and supervising for large dyestuff manufacturer. Thoroughly experienced on rayon, cotton, silk, acetates, printing, vats. Fullest references as to character and ability. Seeks position as technician, consultant, or superintendent with reliable dyestuff sales organization or dyehouse. Age 33, married.

A-B-12

Education—Philadelphia Textile School (Evening), Chemistry and Dyeing, Quantitative and Qualitative Analysis.

Experience—Two years in yarn office, making wool stock blends. Last 6 years in dyehouse, 4 years as kettle hand, 2 years in piece dye work. Worked on yarn, raw stock and piece goods; has been dyer on union piece goods, cotton, rayon and wool, leaving wool white; also worked on all wool fabrics and woolen cross dyes; also considerable laboratory experience doing laboratory dyeings and extraction work. Seeks position as dyer or laboratory technician.

Age 30; married; references.

A-B-13

Education—B.S., Chemical Engineering, Oregon State College, 1926.

Experience—First experience in dry cleaning plant; few months as sampling and control chemist with potash and chemical company; two years in dry cleaning plant, all phases of work; few months on routine and special analyses, plant problems, special studies and research for gas and electric company; 10 years teaching experience on textile chemistry, dyeing and textile testing covering all general and special courses in this field; consultant work with various mills. Seeks position in textile chemistry or dyeing.

Age 37; married; will go anywhere; references.

A-B-C-4

Education—Educated abroad.

Experience—Twenty years experience in the textile field as bleacher, dyer, finisher and chemist. 16 years in charge of dyestuff laboratory of large dyeing plant, 4 years as chief chemist with large bleachery. Has tested dyestuffs, and chemicals used in the textile field and has manufactured soaps and textile specialties. Has handled all textile fibers; bleaching, printing, dyeing and finishing same. Has done pigment and lacquer printing, waterproofing and fireproofing. Reason for leaving last position was due to business conditions.

Age 41; married.

A-B-C-8

Education—B.T.C., 1933, Lowell Textile Institute.

Experience—5 months as rayon slasher tender; 8 months color matching, dye testing and analytical work; 5 years with large print works in rayon finishing department, laboratory, color matching, dye testing, assistant rayon dyer. Seeks position as rayon dyer, assistant dyer, or any job in a rayon dyeing and finishing plant. Age 29; single.

A-B-C-9

Education—Lowell Textile Institute; chemistry, dyeing and textile finishing.

Experience—Twelve years head dyer in hosiery mills. Dyeing all types of fibers and in combination. Knowledge of all dye applications. Matching and formula making. Charge of every department in a hosiery mill except fixing machinery. Has done jigg work on cottons and rayons. Desires position in hosiery, or in any field. Would like to work as an assistant to head dyer in a woolen or rayon mill. Age 42; married. Will go anywhere in the United States.

A-B-C-D-1

Education—Lowell Textile Institute, Bachelor of Textile Chemistry; Lowell Textile Institute (Evenings), 2 years D. C. Electricity; 2 years A. C. Electricity.

Experience—Six years as chemist and assistant dyer with a large organization. Specialized in dyeing, finishing, bleaching and drying of woolens, worsteds, cottons, rayons and unions in the piece. Some sales experience. Desires position as chemist, dyer, finisher, bleacher or sales. Age 30; American citizen; Married.

A-B-C-E-1

Education—3 years Chemical Engineer major in college; honor graduate Philadelphia Textile School, chemistry and dyeing course.

Experience—Ten years experience as chemist, colorist, technical director in bleaching, dyeing and finishing of cottons and rayons. Also one year's similar experience in South America. Instructor of textiles and textile chemistry in state vocational school, 2 years. Married; age 32; references; will go anywhere.

A-B-C-F-1

Education—Textile Institute course in Dyeing and Chemistry; Extension work at Brown University; Executive Training with Alexander Hamilton Institute of New York, N. Y.; working knowledge of one foreign language.

Experience—Dyeing executive on all types of textiles including stock, yarns in the skein, warp and package, and piece goods. Thorough knowledge of all classes of dyes and dyestuffs and their successful practical application in the plant. Extensive knowledge of all types and makes of equipment for dyeing, bleaching, mercerizing and finishing. Laboratory practice in testing, standardizing, purchasing, costing, planning and checking processes, and market analysis. Good manager of personnel for better efficiency in retaining friendly labor relations. Conversant with modern methods for quality production economically secured through better coordination and correct alignment in processing, on cotton, viscose and acetate rayon, silk, wool, worsted, and mixtures. In excellent mental and physical health; excellent references.

A-B-D-1

Education—Special courses in general chemistry.

Experience—Twenty-nine years' experience in application and standardization laboratories of various dyestuff manufacturers. Well versed in the application of dyestuffs to different textile fibers, i.e., wool, cotton, rayon, silk, acetate rayon and unions, using direct, acid, diazo, sulfur, acetate rayon, chrome and after-treated direct dyestuffs. Six months' actual dye house experience on jigs, open boxes, padders, bleaching and mercerizing. Experience demonstrating sulfur and direct colors at various mills. Seeks position as textile colorist in application laboratory and demonstrator.

Age 46; single; references.

A-D-1

Education—Graduate of New Bedford Textile School, 1936.

Experience—Chemist for woolen mill 7 months; technician and salesman for chemical company 1 year and 9 months. Seeks position as salesman or in purchasing department.

Will go anywhere; married; references.

B-5

Education—High School and Textile School Graduate.

Experience—Twelve years overseer of dyeing on directs, vats, naphthols, sulfur, basic and developed colors. Also experienced bleacher. Age 40; married; references.

B-6

Education—Graduate New Bedford Textile School; also post graduate work in advanced microscopy and rayon testing.

Experience—Five weeks in color shop of print works. Wants position in anything associated with textile chemistry, dyeing, finishing and testing.

Single; age 21; references.

B-D-1

Education—General education in England. Chemistry and Dyeing Courses at Huddersfield Technical School.

Experience—Has been a superintendent of dyeing since 1911. Has had experience in worsted mills, hosiery mills and woolen mills. Congenial, sober and reliable. Married; references; age 53.

D-F-1

Education—Graduate of the Massachusetts Institute of Technology, degree of mechanical engineer.

Experience—Four years engineering work consisting of servicing, testing, installing and designing paper box machinery and oil burners. Eight years selling industrial automatic controls, drying equipment and heat treating furnaces. Have made sales market studies and managed a sales office.

Age 36; single, references.

F-1

Education—Two years high school; 6 years evening engineering school; 1 year evening textile school; 1 year industrial management; course in accounting.

Experience—Ten years in an executive capacity in full fashioned hosiery manufacturing business. Familiar with entire manufacturing procedure, finishing dept., dyehouse and office. Specialized in finishing dept. and has good eye for color, finish and quality. Had responsibility of all orders going through mill, stock, grey goods and traffic. Five months in New York sales office. Gets along well with people and contact with employees and customers has always been satisfactory. Previous to hosiery experience was in a mechanical business for 17 years.

43 years of age; single, in good health; will go anywhere.

MEETING, NEW YORK SECTION

THE fifth meeting of the New York Section was held at the Chemists' Club, New York City, on March 29th, 1940. The first speaker was Paul J. Choquette, Chief Chemist, Cranston Print Works, Webster, Mass., whose subject was: "Control in the Processing of Spun Rayon Fabrics." The second speaker was Barrett Fisher, Chief Chemist, Sidney Blumenthal Co., Shelton, Conn., whose subject was: "The Dyeing and Finishing of Pile Fabrics." Both papers were very interesting and the speakers were given a rising vote of thanks.

The annual sectional outing will be held on Friday, June 7th, at the North Jersey Country Club, Paterson, N. J. A. J. Royce will be chairman of the outing committee.

Both Dr. Meili and Mr. Zisman referred to the importance of the coming sectional outing.

Henry Herrmann elaborated on the coming national convention, referring particularly to the special award which is to be offered for the best technical paper presented by any one section at the convention.

P. J. Kennedy, general convention chairman, stated that most of the plans for our convention in October have been completed. He also mentioned that Sunday, October 20th, 1940, will be set aside as a "special day" at the New York World's Fair for our association. A very interesting program has been undertaken in behalf of the women visitors to our convention.

Total attendance: 150.

Respectfully submitted,

P. J. KENNEDY, *Secretary.*

Twentieth

ANNUAL MEETING AND CONVENTION

HOTEL COMMODORE

NEW YORK CITY

OCTOBER 18TH AND 19TH, 1940

General Chairman

PATRICK J. KENNEDY

BUFFET SUPPER COMMITTEE

George Lommel

Robert Ackley

Edward H. Staab

Ernest H. Benzing

Auspices of

NEW YORK SECTION

HAROLD W. STIEGLER
Chairman, Buffet Supper Committee

DR. HAROLD W. STIEGLER of the American Cyanamid Company will be chairman of the buffet supper committee for the twentieth annual meeting and convention. Dr. Stiegler is well known to the members of the association as he has been an active member for many years. He is a member of the research committee and is a councilor from the New York Section. With the cooperation of the able committee members whose names appear at the left you can be assured that the buffet supper will be an enjoyable event.

Finishing Treatments

Applied to Cotton Hose*

MARGARET S. FURRY and LILLIAN E. WEIDENHAMMER**

(Concluded from last issue)

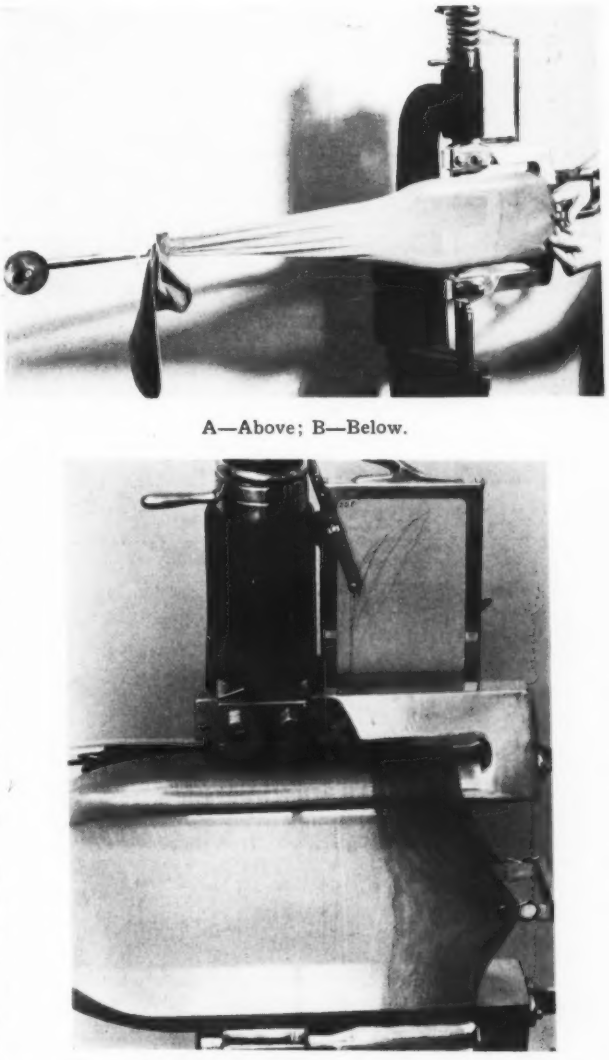
TESTING PROCEDURES

Unfinished hose and hose to which finishing treatments were applied were tested for their elastic properties, weight, and bursting strength after they were laundered one, five, and ten times. All samples were conditioned overnight and tested in a laboratory maintained at 70° F. and 65 per cent relative humidity.

The elastic properties of the upper part of the stocking leg of the cotton hose under test were measured by the hosiery-testing machine[14] designed at the National Bureau of Standards and sometimes referred to as the Frazier machine (Fig. 1). This machine was used since Schiefer and Cleveland[13] concluded that the hosiery-testing machine is suitable for determining the effects of various factors such as finishing, laundering, dyeing, ageing, and construction on the elastic properties of silk hosiery.

In the testing procedure the stocking was placed on the jaws of the machine and the two garter clasps were attached to opposite sides of the welt midway between the jaws and one inch from the top edge. The cord to which the weight of one pound is fastened was attached to the ankle of the stocking three inches above the bottom of the heel. The machine was started and the stocking repeatedly distended from a minimum circumference (distance around the jaws) of 13.3 inches to a maximum of 21.3 inches. An autographic recorder gave the load-circumference diagrams produced through the cycles of test. Each stocking tested was distended through 200 cycles and the stretch properties evaluated from the diagram.

In this study it seemed advisable in evaluating the charts to depart from the procedure recommended by Schiefer and Cleveland[17]. They described the elastic properties of silk hose in terms of "distensibility," "recoverability," and "stretch-endurability." Distensibility was defined by them as "the ratio of the increase in circumference to the increase in load when the load is increased from 20 to 30 pounds in the first cycle of the test." Recoverability meant "the circumference of the stocking at a load of 30 pounds in the first flexing cycle expressed as a percentage of the circumference at a load of 10 pounds in the 200th flexing cycle." Stretch-endurability was "the number of flexing cycles required to produce a failure, that is, a hole or run in the stocking."



A—Above; B—Below.

Figure 1. The hosiery testing machine; A. The stocking ready for test; B. The load-circumference diagram and stocking after 200 cycles of test.

It was found that many of the cotton hose in this study required less than 30 pounds to distend them to the maximum of 21.3 inches. Also the load-circumference diagram at the 200th cycle was more reliable than that at the first cycle. Hence the following values were read from the diagram at the 200th cycle and were recorded:

*Appreciation is expressed to Herbert F. Schiefer of the National Bureau of Standards for cooperation in the interpretation of results obtained with the hosiery testing machine and to the management of E. I. duPont de Nemours & Company; Wolf & Company; Sandoz Chemical Works, Inc.; Scholler Brothers, Inc.; and Röhm & Haas Company for supplying finishing materials.

**Assistant textile chemist and junior chemist, Division of Textiles and Clothing, Bureau of Home Economics.

TABLE 1
Elastic Properties, Bursting Strength

ELASTIC

Cotton Hose	Welt Construction	Yarn Number	Finishing Treatment	Stretch Load per Inch Between 19.2 and 20.2 Inches Circumference (s'-s)			Maximum Load at 21.3 Inches Circumference		
				Laundered Once	Laundered Five Times	Laundered Ten Times	Laundered Once	Laundered Five Times	Laundered Ten Times
Number				Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
A_0	Plain	120/2	Unfinished	14.0	14.8	12.5	68	72	59
A_1	Plain	120/2	Finish 1	5.1**	5.6**	6.7*	25**	28**	37*
A_2	Plain	120/2	Finish 2	7.1**	13.2	16.2	43**	63	80*
A_3	Plain	120/2	Finish 3	7.5**	11.9	10.5	39**	58	54
A_4	Plain	120/2	Finish 4	7.6**	11.3	16.4	36**	61	71
A_9	Plain	120/2	Finish 9	6.5**	[2]	[2]	31**	[2]	[2]
B_0	Stretch	140/2	Unfinished	8.9	...	7.5	43	..	40
B_5	Stretch	140/2	Finish 5	3.8*	...	8.0	20*	..	44
C_0	Plain	60/2	Unfinished	14.6	...	...	65	..	..
C_1	Plain	60/2	Finish 1	7.4**	...	...	38**	..	..
D_0	Plain	70/2	Unfinished	13.5	...	...	62	..	..
D_1	Plain	70/2	Finish 1	6.9**	...	...	33**	..	..
E_0	Plain	80/2	Unfinished	10.9	...	...	54	..	..
E_1	Plain	80/2	Finish 1	5.2**	...	...	27**	..	..
CY_0	Stretch	60/2	Unfinished	14.1	...	...	68	..	..
CY_1	Stretch	60/2	Finish 1	4.1**	...	...	22**	..	..
CX_0	Stretch	60/2	Unfinished	14.5	...	...	73	..	..
CX_1	Stretch	60/2	Finish 1	4.6**	...	...	25**	..	..
F_0	Stretch	90/2	Unfinished	14.1	15.6	19.6	69	78	91
F_1	Stretch	90/2	Finish 1	4.2**	...	...	20**	..	..
F_6	Stretch	90/2	Finish 6	12.4	15.1	10.6**	55	71	50**
F_7	Stretch	90/2	Finish 7	7.6	15.9	20.1	36	72	93
F_8	Stretch	90/2	Finish 8	10.3	15.9	19.7	50	75	91
F_{10}	Stretch	90/2	Finish 10	15.9	15.8	15.2	78	72	71*
G_0	Stretch	100/2	Unfinished	18.9	...	...	83	..	..
G_1	Stretch	100/2	Finish 1	5.9**	...	...	30**	..	..

[1]Two asterisks indicate a highly significant difference between the value so marked for the finished hose and the corresponding value for the unfinished hose; one asterisk indicates a significant difference.
[2]Stretch properties after five and ten launderings for hose treated with this finish could not be obtained since the hose failed to withstand test.

the loads, s, s', and maximum load, required to distend the stocking to 19.2 inches circumference, to 20.2 inches, and to 21.3 inches respectively, and the load at 19.2 inches, r, with which the stocking recovers from the maximum distension (Fig. 2). The circumference of

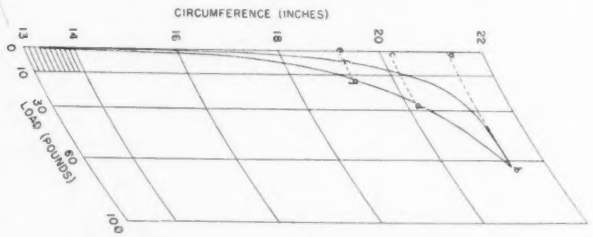


Figure 2. Load-circumference diagram of the 200th cycle for a cotton stocking; e.g., Load required to stretch stocking to 19.2 inches circumference (s); cd, Load required to stretch stocking to 20.2 inches circumference (s'); ab, Load required to stretch stocking to 21.3 inches circumference (maximum load); ef, Load at 19.2 inches circumference with which stocking recovers (r).

19.2 inches was used since from actual measurements made on 50 individuals United States Testing Company found this to be the circumference of that part of a woman's leg 5 inches above the knee that corresponds to the welt of the stocking.* They have used the load required to distend the stocking to 19.2 inches circumference at the 200th cycle and also the stretch-endurability for rating silk hosiery[18].

*In correspondence with United States Testing Company, Hoboken, N. J.

In this study the elastic properties of cotton hose are associated with the following values: the stretch load per inch, s'-s, measured at 20.2 and 19.2 inches circumference; the maximum load at 21.3 inches circumference; the recovery load at 19.2 inches circumference, r; and the stretch-recovery ratio, $\frac{s'-s}{r}$. These properties describe the behavior of the upper portion of the stocking when it is subjected to forces similar to those which occur at the knee and at the garter clasps in wear.

Stretch load per inch measures the ease with which a stocking can be stretched. Stockings for which this value is small can be stretched easily while stockings with large stretch load per inch offer great resistance.

Maximum load, which is also a measure of the ease of stretch, is so called because it is the load necessary to stretch the stocking to the maximum circumference of 21.3 inches, to which the machine is adjusted.

The recovery load, or the load with which a distended stocking recovers, may be regarded as the force with which the stocking clings to the leg at the circumference of 19.2 inches. A stocking with a high recovery load presumably fits snugly, while one with a low recovery load may be baggy.

The stretch-recovery ratio is an arbitrary value calculated from stretch load per inch and the recovery load. It has the advantage of combining in one number the measures describing the stretch and the recovery of a stocking.

and Weight of the Cotton Hose[1]

PROPERTIES

Recovery Load at 19.2 Inches (r)			*Stretch Recovery Ratio* $\left(\frac{s'-s}{r}\right)$			*Bursting Strength*			*Weight Per Square Yard*		
Laundered Once	*Laundered Five Times*	*Laundered Ten Times*	*Laundered Once*	*Laundered Five Times*	*Laundered Ten Times*	*Laundered Once*	*Laundered Five Times*	*Laundered Ten Times*	*Laundered Once*	*Laundered Five Times*	*Laundered Ten Times*
Pounds	*Pounds*	*Pounds*				*Pounds*	*Pounds*	*Pounds*	*Ounces*	*Ounces*	*Ounces*
3.1	3.0	2.4	4.6	5.0	5.9	34	34	32	1.89	1.87	1.80
4.8**	4.3**	4.0**	1.0**	1.2**	1.7**	36	36	34	1.93	1.95	1.94*
4.0**	3.4	2.9	1.8**	3.8	6.1	38*	35	35	1.89	1.90	1.99**
4.0**	3.5	2.9	1.8**	3.4*	3.7	35	33	34	1.89	1.87	1.80
3.8**	2.8	1.8	2.1**	4.1	9.4*	37	33	33	1.91	1.92	1.86
5.7**	[2]	[2]	1.1**	[2]	[2]	28**	26**	26**	1.88	1.87	1.87
2.0	..	2.0	4.4	..	3.7	40	..	37	1.82	..	1.75
3.3**	..	2.0	1.2*	..	4.0	36	..	37	1.75	..	1.77
4.9	..	..	3.1	..	..	68	..	..	3.55	..	..
6.8**	..	..	1.1**	..	..	70	..	..	3.72*	..	..
5.1	..	..	2.6	..	..	58	..	..	3.17	..	..
5.9*	..	..	1.2**	..	..	62*	..	..	3.23	..	..
4.8	..	..	2.5	..	..	48	..	..	2.59	..	..
5.4	..	..	.95**	..	..	45	..	..	2.57	..	..
2.6	..	..	5.6	..	..	55	..	..	3.53	..	..
4.8**	..	..	.86**	..	..	63**	..	..	3.64	..	..
2.6	..	..	5.7	..	..	46	..	..	3.66	..	..
4.5**	..	..	.99**	..	..	43	..	..	3.62	..	..
2.3	1.7	1.5	6.2	9.2	14	47	43	46	2.41	2.44	2.40
4.3**	..	..	.97**	..	..	47	..	..	2.48	..	..
4.1**	2.4**	2.6**	2.9*	6.3*	4.2	49	45	46	2.47	2.39	2.38
3.9**	1.7	1.3	1.9**	9.4	16	46	44	45	2.36	2.29	2.36
4.2**	1.9	1.3	2.4*	8.6	16	52	44	38**	2.54	2.27	2.35
1.9	1.5	1.1	8.7	10.8	14	47	45	44	2.45	2.24	2.29
1.8	..	..	11	..	..	38	..	..	2.20	..	..
4.4**	..	..	1.3**	..	..	40	..	..	2.41**	..	..

TABLE 2

The Effect on Properties of Finished Hose of Laundering One, Five and Ten Times

Cotton Hose	*Finishing Treatment*	*Source of Variation*	*ELASTIC PROPERTIES*					*Bursting Strength*		*Weight per Square Yard*	
			Degrees of Freedom	*Mean Square*[1]				*Degrees of Freedom*	*Mean Square*[1]	*Degrees of Freedom*	*Mean Square*[1]
				Stretch Load per Inch $(s'-s)$	*Maximum Load*	*Recovery Load* (r)	*Stretch-Recovery Ratio* $\left(\frac{s'-s}{r}\right)$				
Number											
A_0	Unfinished	Between	2	6.8	231	.80*	1.97	2	9.0	2	.0097
		Within	12	21.5	408	.17	5.22	12	9.3	12	.0046
A_1	Finish 1	Between	2	3.2	186	.76	.525	2	5.3	2	.00027
		Within	12	3.1	63	.28	.150	12	9.7	11	.0044
A_2	Finish 2	Between	2	106**	1710**	1.56*	23.1**	2	18	2	.017
		Within	12	5.0	87	.31	1.51	12	9.0	12	.0055
A_3	Finish 3	Between	2	21.3	426	1.22**	3.95	2	3.7	2	.0084
		Within	10	10.4	175	.081	1.20	11	10	11	.0035
A_4	Finish 4	Between	2	98.0**	1660*	4.80*	71.6**	2	22*	2	.0052
		Within	12	12.4	252	.89	3.80	12	4.0	12	.0043
A^9	Finish 9	Between	..	[2]	[2]	[2]	[2]	2	6.5	2	.00012
		Within	..	[2]	[2]	[2]	[2]	11	8.3	11	.0033
B_0[3]	Unfinished	Between	1	3.2	8.2	0	0.66	1	9.9	1	.015
		Within	4	3.6	117	.085	1.28	4	4.3	4	.0085
B_5[3]	Finish 5	Between	1	26.0**	821**	2.40*	11.5**	1	3.5	1	.0076
		Within	4	.062	5.9	.042	.33	4	9.4	4	.0042
F_0	Unfinished	Between	2	28.2	428	.70*	52.1**	2	16	2	.0015
		Within	7	13.7	219	.077	4.72	8	6.1	8	.012
F_6	Finish 6	Between	2	15.2	376	2.48*	8.96	2	14	2	.0081
		Within	6	29.8	521	.33	2.13	6	9.1	6	.0059
F_7	Finish 7	Between	2	120**	2540**	5.88**	149**	2	3.4	2	.0044
		Within	6	1.5	25	.040	5.20	6	7.9	6	.0022
F_8	Finish 8	Between	2	53.4	1020	5.18**	104**	2	157**	2	.060**
		Within	5	12.7	185	.11	3.09	6	9.3	6	.0049
F_{10}	Finish 10	Between	2	.36	36	.44*	20.2*	2	5.7	2	.037**
		Within	6	1.2	16	.068	2.35	6	3.4	6	.0032

[1]Two asterisks indicate that the between variation due to laundering is highly significant in comparison with the within variation due to the non-uniformity of the hose; one asterisk indicates a highly significant difference.
[2]No calculations could be made for the elastic properties of these hose. See Table 1, footnote 2.
[3]The e hose were laundered only one and ten times.

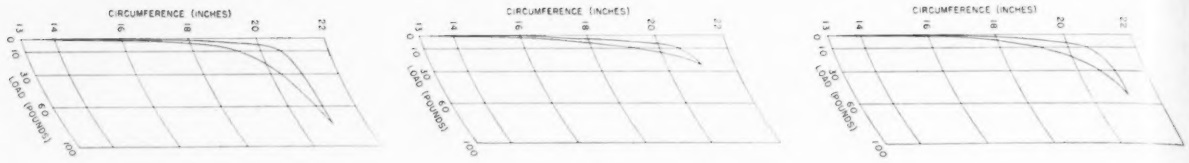


Figure 3. Load-circumference diagrams of the 200th cycle for cotton stockings laundered once; A. No finishing treatment; B. Treated with finish 1; C. Treated with finish 2.

Bursting strength tests or measurements of resistance to popping were made on the hose according to the method given by Schenke and Shearer[15]. The load at rupture was recorded. A 2-inch square steel die was used to stamp out the fabric weight samples, which were then weighed on an analytical balance.

DISCUSSION OF RESULTS

Elastic Properties

Each value for elastic properties reported in Table 1 is the average of 5 determinations except those for lots B_0 and B_1 and F_6, F_7, F_8 and F_{10}, which are averages of 3 determinations. In order to evaluate the differences in properties between hose treated with the various finishes, these and all succeeding data were analyzed statistically. The results are given in Table 1 and Table 2.

In Table 1, an asterisk beside the mean denotes that this value is significantly different from the corresponding value for an untreated hose, two asterisks denote a high degree of significance. Similarly in Table 2, one asterisk indicates that the variation due to laundering is significant and two asterisks that it is highly significant. Statistical significance merely means that there is a high degree of probability that a repetition of the experiment will give similar results. Where numerically large differences are obtained, if statistical analyses show that the difference is not significant, no great confidence can be placed in the likelihood of obtaining such a difference again. This is very often true when variations due to factors beyond the control of the experimenter become very large. In this study probably the large within variation is due to the non-uniformity of the cotton hose.

The range for the stretch-load-per-inch values is from 3.6 to 20.1 pounds. So far as the unfinished hose are concerned, differences in welt construction are not apparent by this measure. For example, the stretch-load values for plain-top stockings C_0, D_0, and E_0, are 14.6, 13.5, and 10.9, which are not very different from the values, 14.1 14.1, and 18.9, for the stretch-top stockings CY_0, F_0, and G_0. However, on application of a finish, stretch-top stockings are affected considerably more than plain-top. The values, 7.4, 6.9, and 5.2 for plain-top hose C_1, D_1, and E_1, treated with finish 1 are just half as large as those for the untreated; whereas the values, 4.1, 4.2, and 5.9, for the stretch-tops CY_1, F_1, and G_1, are only a third of those in the corresponding untreated group. Apparently, these treated plain-top stockings stretch twice as easily, and the treated stretch-top stockings stretch three times as easily as those without the finish.

In general, finished hose stretch more easily than the untreated hose, as is indicated by the reduction of the stretch-load values that finishing treatments produce. This is shown graphically by the load-circumference diagrams (Fig. 3). Hose treated with all the finishes except 6, 8, and 10 have values approximately half as great as that for the corresponding untreated hose. Finishes 6 and 8, insoluble soaps, decrease stretch-load somewhat, but finish 10, the methyl acrylate resin, increases it slightly though the differences are not significant. On repeated laundering stretch-load values of finished hose become higher; whereas the values for the unfinished hose do not change significantly. Hose treated with finish 1, octadecyloxymethylpyridinium chloride, have stretch-load values significantly different from those of the corresponding untreated even after five and ten launderings. Hose treated with the other finishes do not differ from the untreated laundered five times. This would indicate that only finish 1 had not washed out.

The range for all the values of the maximum load is from 18 to 93 pounds. Maximum load closely resembles the measure of stretch load per inch. Maximum load is affected by welt construction, finishes, and repeated laundering in practically the same manner as stretch load.

The data on recovery-load, or r, value shows that while the range is only from 1.1 to 6.8 pounds there are distinct differences in the force with which different hose cling to the leg. Apparently the construction of a stocking welt influences recovery load. That for a stretch-top is generally lower than that for a plain-top. The r values 4.9, 5.1, and 4.8, for the plain-top experimental hose C_0, D_0, and E_0, are very much higher than those, 2.6, 2.3, and 1.8, for the stretch-top stockings, CY_0, F_0, and G_0. It is true that there are various yarn sizes in these two groups, but the small range within each group indicates plainly that recovery load apparently is not related to yarn size. Therefore, the large difference observed is no doubt due to welt construction.

The effect of finishing treatments generally is to give increased recovery load. Statistical analyses show that the r value for hose treated with each finish, except finish 10, methyl acrylate resin, are significantly greater than that for the corresponding unfinished hose (Table 1).

Repeated laundering lowers recovery-load values, which means that these stockings tend to fit more loosely after they have been laundered a number of times. After ten launderings, the r values for hose treated with finishes 1 and 6 are significantly higher than those for the corre-

sponding untreated hose. In the case of finish 9, urea-formaldehyde resin, after five launderings, two hose out of five failed in test and after ten launderings, three out of four failed.

Since no actual numerical values could be obtained for those hose that failed, there is no way of arriving at a true average for any of the values measuring elastic properties. Hose treated with all the other finishes apparently have lost after ten launderings all the recovery-load they had gained from the finishing treatments. So far as this measure is concerned, finishes 1, octadecyloxymethylpyridinium chloride, and 6, chrome alum soap, are the only ones that do not wash out.

The stretch-recovery ratio, $\frac{s'-s}{r}$, as noted above is an arbitrary value that has no special physical significance but combines mathematically the two measures that seem to estimate best the elastic properties of the hose. An effect that produces a small stretch-load, an easily stretched stocking, and/or a large recovery-load, a snug fitting stocking, will of course produce a small stretch-recovery ratio. These ratios, except for hose treated with methyl acrylate resin, are very much lower for the treated than for the untreated hose. After ten launderings the ratios are generally much larger than after the first laundering except those for hose treated with finishes 1 and 6. The ratios for these finishes are significantly lower than those for the corresponding untreated also laundered ten times. The values for the stretch-recovery ratio range from 0.86 to 11 and those for the stretch-top stockings are higher than those for the plain-top.

In evaluating the elastic properties of hose, account must be taken of the fact that in the stretch-top stocking the welt construction is entirely different from that of the main part. The area being tested is therefore not so uniform as in the plain-top stocking. It is difficult to estimate the influence that the welt has upon the performance of the test area as a whole.

The elastic properties of plain-top hose evaluated by the method used in this study were compared with those suggested by Schiefer and Cleveland[17]. Only plain-top stockings were used in this comparison since the specifications set up by Schiefer and Cleveland are presumably for plain-top silk hose. They specify that a satisfactory stocking should have a "distensibility" of at least 0.11 inches per pound and a "recoverability" of at least 96 per cent. The load circumference diagrams for hose A_0, A_1, A_2, A_3, A_4, and A_9 were read by their method also and the values for the stretch-recovery ratio of each individual hose were then grouped according to their specifications.

In the first group were placed the values of the hose that met both specifications, in the second group those that met one but not the other, and in the third group those that met neither specification. The stretch-recovery ratio values for the 35 individual hose that met both specifications range from 0.64 to 2.6 and for the 32 that met neither specification from 3.2 to 11.6. The intermediate group of 15 shows a range of values from 1.8 to 4.3. Even though there is an overlapping of the values here, the clear cut separation of the first and third groups indicates that the results obtained by these two methods are not vastly different, and plain-top stockings with a stretch-recovery ratio less than 3 would be satisfactory.

Bursting Strength and Weight

The values for bursting strength and weight given in Table 1 are averages for 5 hose expect those for lots B_0 and B_1 and F_6, F_7, F_8, and F_{10}, which are averages for 3 hose. The range of bursting strengths exhibited by these hose is fairly great—from 26 to 70 pounds. The all-cotton hose, C_0, are significantly stronger than those, CX_0, made from a rayon and cotton mixture.

Finishes generally produce a slight increase in bursting strength but only in the case of finish 2, a wax emulsion, is the increase significant. It is worthy of note that, while these finishing treatments do not apparently strengthen the hose to any extent, they do not have any adverse effect that would weaken them. Finish 9, urea-formaldehyde resin, is an exception since the bursting strength of hose treated with this finish is significantly lower than that of a similar untreated hose. Loss in breaking strength due to a urea-formaldehyde resin similar to finish 9 has been noted before.

Laundering has a slight weakening effect on both the unfinished and the treated hose. After ten launderings those treated with finish 2 are no longer significantly stronger than the untreated laundered ten times. Ten launderings in the case of finish 8, the cadmium soap, have weakened the hose significantly.

The range in weight per square yard for the hose is from 1.75 to 3.72 ounces. This variation is apparently due to differences in yarn size and not to finishing treatments or laundering. The increase in weight with heavier yarns is very much smaller proportionately than the simultaneous increase in bursting strength. Statistical analysis by covariance shows that the variation in bursting strength between hose of different yarn size is still highly significant even after due allowance is made for differences in weight.

SUMMARY AND CONCLUSIONS

In order to determine the effectiveness of finishing treatments in improving the properties of cotton hose, a study was made of the elastic properties, bursting strength, and weight per unit area of cotton hose to which ten finishing treatments were applied. Results were obtained for both untreated and treated hose that were laundered one, five, and ten times. The data were analyzed statistically.

The ten different finishing treatments that were applied, are of four general types: finish 1, a chemical compound reacting chemically with cellulose; finishes 2, 3, 4 and 5, wax and aluminum salt emulsions; finishes 6, 7, and 8, insoluble soaps of chromium, aluminum, and cadmium; and finishes 9 and 10, synthetic resins.

Hose treated with finish 1 even after repeated launder-

ings are consistently different from untreated hose in all their properties except bursting strength and weight. Stretch load, maximum load, and the stretch-recovery ratio are smaller, and recovery-load is greater; which means that these hose stretch more easily and fit more snugly than similar untreated hose.

Finishes 2, 3, 4, and 5, the wax emulsions, are similar to each other in their effect on the elastic properties. They decrease the stretch load per inch, the maximum load, and the stretch-recovery ratio, and increase the recovery load. Thus stockings treated with these finishes also stretch easily and fit snugly. Finish 2 is the only finish that increases bursting strength. However, the effectiveness of these finishes is practically gone after five launderings.

Hose treated with finishes 6, 7, and 8, the insoluble soaps, exhibit similar properties. The effect of these finishes on the elastic properties is difficult to interpret, since the decreases in stretch load per inch and maximum load are not significant, whereas recovery load is definitely increased and the stretch-recovery ratio definitely decreased. The chrome alum soap is the only one of these insoluble soaps that does not wash out completely. After ten launderings, the bursting strength of hose treated with the cadmium soap is significantly less than that of the untreated laundered ten times. The other two soaps do not cause such a loss in strength on laundering.

Finishes 9 ond 10 although both synthetic resins behave very differently. The urea-formaldehyde resin, finish 9, changes all the properties to a marked extent. It increases recovery load, and decreases the stretch load per inch, the maximum load, and the stretch-recovery ratio. It is not satisfactory, however, since hose treated with it are definitely weaker than untreated hose. After only five launderings, they were so weakened that holes appeared after the first few cycles of distension in the test for elasticity. Finish 10, the methyl acrylate resin, has practically no effect on the properties of cotton hose studied here. Whatever effect there is, seems to be to decrease elasticity.

In this work, some finishes commonly used at the present time were studied. However, there remains a large number of other finishes of these same types and of different types, that could be profitably investigated.

From the results obtained in this study, it is evident the methods used here for testing elastic properties, and bursting strength are entirely satisfactory for determining the effectiveness of finishing treatments on cotton hose. Investigation of methods for testing such additional properties as water repellency or "splashproofness," and snag resistance would no doubt be valuable.

LITERATURE CITED

[1]Chwala, A. 1938. Uber Hydrophobierung von Faserstoffen. Melliand Textil Ber. *19*, 905-910.

[2]Koons, L. O. 1936. Spot-proofing and Repellent Finishes on Hosiery. Amer. Dyestuff Reptr. *25*, P213-P214.

[3][U. S.] National Bureau of Standards. 1935. Treatments for Silk Stockings. [U. S.] Natl. Bur. Standards Letter Cir. LC-436, 2 pp. [Mimeographed.]

[4]Powers, Donald H. 1938. Progress in the Resin Finishing of Textile Fabrics. Amer. Dyestuff Reptr. *27*, 688-689.

[5]Hodgins, T. S. and Hovey, A. G. 1938. Urea-formaldehyde Film-forming Compositions. Indus. and Engin. Chem., Indus. Ed. *30*, 1021-1029, illus.

[6]Wakelin, J. 1938. The Possibilities of Synthetic Resins in Dyeing, Printing and Finishing. Textile Colorist *60*, 157-160.

[7]Smith, R. J. 1938. Permanent Finishes. Textile Colorist *60*, 763-767, 773.

[8]Amick, Chester. 1935. Crease-resisting Fabrics. Amer. Dyestuff Reptr. *24*, 553-557, 622-624, 632-633, 645-648, 665.

[9]Wall, C. L. 1938. Crease-resisting Finishes. Textile Mfr. *64*, 164-167.

[10]Smith, Lee T. and Claborn, H. V. 1939. Utilization of Lactic Acid. Indus. and Engin. Chem., News Ed. *17*, 370-371, illus.

[11]Strain, D. E., Kennelly, R. Grice and Dittmar, H. R. 1939. Methacrylate Resins. Indus. and Engin. Chem., Indus. Ed. *31*, 382-387, illus.

[12]Renfrew, A. and Caress A. 1937. Styrene and Acrylic Resins. Soc. Chem. Indus. Jour., Chem. and Indus. *56*, 682-684.

[13]Schiefer, Herbert F. and Cleveland, Richard S. 1935. Factors Affecting the Performance of Hosiery on the Hosiery Testing Machine. [U. S.] Natl. Bur. Standards Jour. Res. *14*, 1-16; illus. (Reprinted as Research Paper 753.)

[14]Schiefer, Herbert F. and Appel, William D. 1934. Hosiery Testing Machine. [U. S.] Natl. Bur. Standards Jour. Res. *12*, 543-549, illus. (Reprinted as Research Paper 679.)

[15]Schenke, E. Max and Shearer, Howard E. 1938. Methods of Testing Hosiery. [U. S.] Natl. Bur. Standards Cir. 422, 34 pp., illus.

[16]Furry, Margaret S. 1939. Crease-resistant fabrics. Jour. Home Econ. *31*, 241-242.

[17]Schiefer, Herbert F. and Cleveland, Richard S. 1935. A Basis for a Performance Specification for Women's Full-Fashioned Silk Hosiery. [U. S.] Natl. Bur. Standards Misc. Pub. M149, 14 pp., illus.

[18]United States Testing Company, Inc. 1939. Service Bulletin, No. 14, 5 pp. [Mimeographed.]

Lecithin from Soy Bean

(Continued from page 220)

savings of the expensive cocoa butter.[2] In the soap industry lecithin is used to increase cleaning efficiency because of its emulsifying power and alkali neutralizing effect.[3] It also increases emulsification of soaps in solvents.[4] In the cosmetic industry it is used for its nourishing effect on the skin.[5, 6] Lecithin is used as accelerator in the vulcanization of rubber, it facilitates mixing and acts as softener.[7] It is also used as homogenizing and plasticizing agent for resinous plastics mixtures and linoleum cement.[8] Its properties as an anti-oxidant is taken advantage of in the vegetable oil industry as a retarding agent of rancidity.[9] Also in gasoline, additions of .01-1.5 per cent prevent gum formation.[10] In the mineral oil industry it is used as emulsifying agent for asphalt and tar emul-

sions,[11] also as penetrant for creosote in the impregnation of wood.[12] Mentioned should also be its use as dispersant for pigments,[13] such as poisonous pigments in plant sprays and in color pigments. In electroplating it acts as a protective colloid and produces finer and more uniform coating.[14] Lecithin is also of great interest to the leather and textile industries, though its possibilities seem to have been insufficiently investigated and exploited.

USE IN TEXTILE INDUSTRY

Lecithin from soy beans is produced by a patented process,[15] whereby the beans after cleaning and drying are finely ground in specially designed roller mills. The soya oil is separated from the ground beans with organic solvents in huge extraction plants. Thus by avoiding use of oil presses a specially pure product is obtained. Soya lecithin is obtained as a pasty yellow-brown material, which is brought into a form adaptable for use in the textile industry. The great utility of lecithin in the textile industry is mainly due to its emulsifying and its unusual softening properties. Its emulsifying properties are due to hydrophyllic groups in the molecule which cause it to swell in water to form colloidal emulsions. Conversely the absence of such groups are the reason for water insolubility of the oils. Lecithin reduces surface- and interfacial tension and thus is adaptable as an emulsifying and wetting agent. Its aqueous emulsion is golden yellow and does not stain the fiber. A specially bleached product is available for use on light shades and on white. Lecithin emulsions are stable to alkali but acids will break them down. Tests in laboratory and textile plants revealed suitability in many phases of textile processing as follows:

Spinning: Soya lecithin in aqueous emulsion was proven to be suitable as a lubricant in wool and cotton spinning. It can be used by itself or may be mixed with olein in any proportion. The result is a yarn of excellent softness. Since it has been tried out successfully in rayon spinning of long filament rayon it should also prove of value in the spinning of staple fiber yarns.

Kier Boiling: The behavior and action of lecithin is quite remarkable when it is used in the pressure kier. Both alkalinity and time of boiling can be cut down when relatively small quantities are added. Due to its emulsifying power the goods become open, very soft and are well cleaned.

Substantivity: It should be noted that the product has a rather strong affinity for the fiber and is not removed by subsequent washing. That is the reason why the softening effect is quite permanent. For when a piece of knitted material, which had been kier-boiled for 5 hours in the presence of lecithin was boiled in 10 per cent caustic soda for about 70 hours, the lecithin was still present. This remarkable affinity suggests uses such as for permanent finishes and probably also as a weighting agent for rayons and other fibers. In this connection it might be interesting to note that lecithin has a quaternary ammonium compound in its constitution.

Dyeing: Addition to the dye bath (except of course acid dye bath) aids in softening of goods and in level dyeing. Lecithin also produces clearer and more brilliant shades in direct as well as vat dyeing. In vat dyeing it also prevents too rapid and uneven oxidation of the leuco-compounds of the dyes.[16] It protects the fiber from the action of alkali and improves subsequent winding operations.

Printing: Addition of lecithin to the print paste tends to produce clearer shades and sharper prints. It acts as stabilizer for the various components of the print paste and allows the paste to be scraped off clean by the doctor blade. It can also replace some of the more expensive gums. Additions recommended are 50 parts of lecithin to 1000 parts of printing paste.

Finishing: Lecithin is—despite the many excellent synthetic finishes on the market today—an interesting finishing agent. It is not built on a "fatty" basis, therefore it does not produce stickiness, but makes the fiber fluffy and voluminous. It produces an unusually soft and pleasing hand and beautiful luster, both fairly permanent. It is suitable for finishing of cotton, wool, silk and especially rayons. It is difficult to specify amounts, because this depends on the construction of goods and hand desired. Generally it may be said, that the amounts are very small—it is more often the case that too much has been applied instead of too little. For instance: for rayon fabrics of medium weight ½ to 3 grams of lecithin per liter with or without the addition of ½ gram of soda ash, at a temperature of 50° C. produces a very satisfactory finish. Often the lecithin can be added to the dye bath or the last rinse after dyeing and no extra finishing operation is necessary. Goods do not become stiff during drying and it would be decidedly worthwhile to experiment with this product in connection with crease-proof finishes (urea-formaldehyde resins). Experiments also showed satisfactory effects in cotton finishing as well as in finishing of wool, mohair and mixed fabrics. Rayon yarns before being twisted were treated for 20 minutes at 45° C. with

2 gr. lecithin,
1 gr. soap,
½ gr. soda ash per liter, then dried.

It was found, that the yarn after twisting was very even, soft and strong. Also yarns so treated wound exceptionally well.

SPECIAL USES

Quite a number of American and foreign patents have been taken out protecting the uses of lecithin in the various industries. Of special interest among these is one in connection with the manufacture of spraying oils,[17] applied to cotton fibers prior to spinning. For best results, i.e., most efficient wetting, penetration and even spreading a low surface tension of the spraying oil is desirable. Small quantities of lecithin are compounded with a light petroleum hydrocarbon oil and this product immediately surrounds the fibers with a fine film when brought into contact with them, without globulation or localization of the compound. Other wetting agents, such as a water soluble soap, are added for complete emulsification of the mineral

oil. An example of the proportions of the components is the following:

Mineral oil	94 parts
Sodium naphtenate	5 parts
Lecithin	1 part

Another patent protects the softening and lubricating properties of lecithin as an addition to coning oils for rayon yarns. Since relatively large amounts of vegetable oils are used in coning oils to assure softness of the yarn these oils were rather expensive. The proportion of vegetable oils can be greatly reduced by incorporating lecithin in the coning compound. Conversely the amount of mineral oil—the cheap component—can be increased. It is interesting to note the following statements in the patent: The compound containing lecithin produces a yarn which can be knitted with 20 per cent fewer breaks than the same yarn treated with the compound without lecithin or phosphatide. A better formation of loops in knitted goods is provided. When the yarn is boiled off, there is a uniform and more nearly complete removal of composition than has hitherto been obtained.

Other uses are protected by patents,[19] such as dressing, sizing and softening oil, comprising an emulsion of soya bean phosphatides in extracted condition and chemically uncombined fatty oil, fatty acid or turkey red oil and water.[20] Lecithin is also successfully combined with sulfonated oils, increasing their softening effect and is also added before sulfonation according to a foreign patent. It should also be mentioned, that it is applied as an anti-oxidant in sulfonated oils and tallow.

Its possibilities however do not seem to have been fully investigated and undoubtedly warrant the attention of the textile mill man and the textile chemical manufacturer alike.

REFERENCES

[1]F. W. Thiele. U. S. Pat. 1,843,051.
[2]S. Jordan. U. S. Pat. 1,859,240.
[3]E. L. Lederer. Seifens. Ztg. *60*, 919 (1933); *62*, 180 (1935). K. Braun. Dtsche. Parf. Ztg. *21*, 238 (1935).
[4]J. Augustin. Am. Perf. & Essent. Oil. Rev. Sept., 1932.
[5]J. Augustin. Seifens. Ztg. *61*, 161 (1934); G. Génin. Parf. Moderne *28*, 75, 77 (1934); A. Matagrin. Rev. chim. ind. *45*, 72 ff (1936).
[6]J. Augustin. Seifens. Ztg. *62*, 174 (1935).
[7]B. Rewald. U. S. Pat. 1,946,333.
[8]F. Frank. U. S. Pat. 1,977,940.
[9]H. S. Olcott, H. A. Mattill. Oil & Soap *13*, 98 (1936).
[10]E. I. Sollmann. U. S. Pat. 1,884,899.
[11]Brit. Pat. 382,432.
[12]Germ. Pat. 597,183.
[13]E. Stock. Farben Ztg. *38*, 905 (1933).
[14]F. Jorre, G. Stahlmann. Germ. Pat. 601,036.
[15]H. Bollmann. U. S. Pat. 1,464,557.
[16]B. Bolen. U. S. Pat. 2,020,496.
[17]U. S. Pat. 2,002,885.
[18]U. S. Pat. 2,017,242.
[19]B. Rewald. U. S. Pat. 2,020,517.
[20]O. Mecheels. Melliands Textilber. *12*, 123 (1931). H. Francke. Zeitschr. f.d.ges. Textilind. *36*, 296 (1933).

An Interesting Use for Abnormal Coupling Methods in Producing

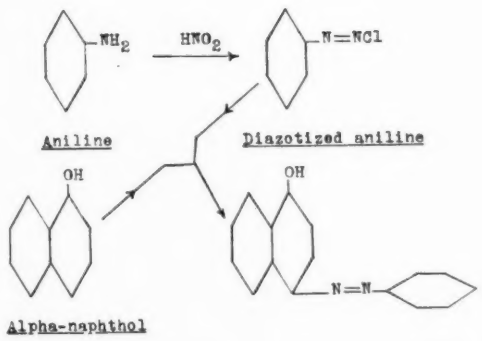
Fast Shades on Wool

With Azoic Dyes

A. J. HALL, B.Sc., F.I.C., F.T.I.

FROM very early times, in fact, since the early discovery of the diazo reaction some fifty years ago by Peter Griess, it has been known that in many cases the simple coupling of a diazotized compound with an aromatic body containing amino or hydroxy groups to form an azo dye can "take the wrong turning" unless certain essential conditions during the reaction are maintained. In order that the coupling shall proceed along the desired lines it is necessary to ensure that the required acid or alkaline conditions exist, and that the coupling components are present in the correct proportion. In the absence of these conditions unusual colored products are formed and as will appear in this article they can be useful in the coloring of wool materials.

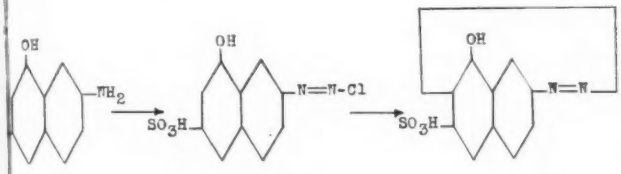
The diazotization of a simple amine (aniline) and its coupling with a naphthol (alpha-naphthol) to form an azo dye takes place according to the following scheme:



In this instance it is to be noted that coupling takes place in alkaline conditions and the presence of the hydroxy group (OH) in the naphthol is the inducement for the diazotized aniline to couple with it—diazotized

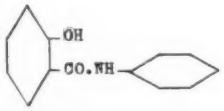
aniline does not couple with naphthalene itself. Here is an example of a dye formed by union of two separate molecules by the azo linkage —N=N—. But if the diazotized compound also contains an hydroxy group then there is the possibility that self-coupling can take place; the azo linkage will then internally unite two parts of the same molecule. It is possible to utilize this special reaction in the coloring of wool.

The following scheme illustrates how an aminonaphthol sulfonic acid can be diazotized and coupled with itself:



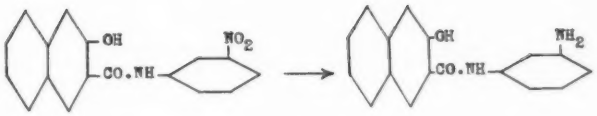
Now wool is an amphoteric substance in that it is able to combine with acid or basic substances according to the pH conditions under which they are applied. It is therefore possible for wool to absorb amino-hydroxy substances when applied to it in solution or as well dispersed suspensions. Obviously wool so treated can then be reacted with nitrous acid to effect diazotization of the amino groups so that on plunging the wool into dilute alkali self-coupling can take place and the wool become colored with an azo compound. This possibility seems to have been first foreseen by Turski (Textilber., 1937, *18*, 75) and to have been made the basis of a practical method for dyeing wool (Ger. Patent, 552,926; English Patent, 347,-609). More recently this method of dyeing has been extended to cover the dyeing in solid shades of wool-rayon mixture materials (English Patent, 503,134).

It will be remembered that the Naphthol AS dyes, which are increasingly applied to cotton goods because they yield shades of such excellent fastness, are produced by coupling a diazotized base with a derivative of beta-oxynaphthoic acid which has the following constitution:



Similar derivatives contain amino groups while others contain nitro groups which can be reduced under suitable conditions to amino groups. They are therefore quite suitable for use in coloring wool in which self-coupling is utilized. The following is an example of the manner in which such products can be used:

Meta-nitroanilide of beta-oxynaphthoic acid is Naphthol AS-BS (a naphthol which is frequently applied to cotton and then coupled with Fast Scarlet RC base to produce fast scarlet shades) and this can be converted into meta-aminoanilide of beta-oxynaphthoic acid thus:



For this, 308 grams of meta-nitroanilide of beta-oxynaphthoic acid is suspended in one liter of water at 60 to 65° C. and then 390 grams of a 61 per cent solution of sodium sulfide gradually added. Reduction takes place and the aminoanilide compound goes into solution. After the reaction is complete, the product is filtered and then neutralized with acetic or a mineral acid to precipitate the meta-aminoanilide of beta-oxynaphthoic acid; this latter substance can then be filtered off, washed, and dried so as to be ready for application to wool.

Instead of the meta-nitroanilide of beta-oxynaphthoic acid it is possible to use 322 grams of the meta-amino-ortho-toluidide of beta-oxynaphthoic acid and reduce this to the corresponding amino compound by the same method as that described above, and then use this product for dyeing wool.

In the dyeing process, the wool material is padded with a solution of say meta-aminoanilide of beta-oxynaphthoic acid (the presence of a minimum amount of caustic soda is required to assist its dissolution), then treated with a solution of nitrous acid (sodium nitrite and hydrochloric or acetic acid) to effect diazotization, followed by rinsing with a weakly alkaline liquor for promoting self-coupling. Under these conditions the wool is dyed a vivid red shade which is fast because the red dye is water-insoluble and is formed within the wool fibers.

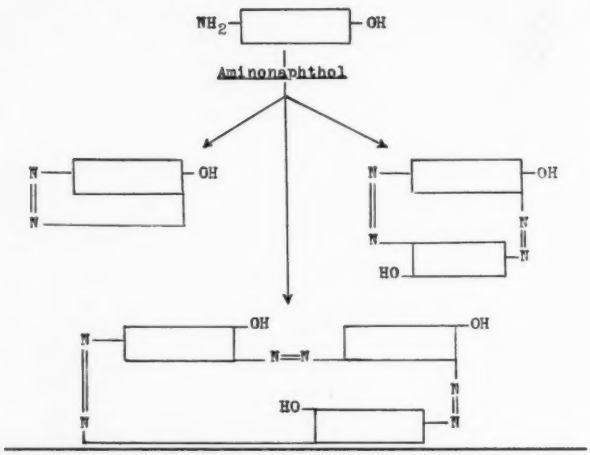
It is possible to use in a similar manner the amino-anilides of salicylic acid, pyrazolone carboxylic acids, and of aminobenzoic acid. By a diazotizing and self-coupling process, yellow shades may be produced with mono-salicyl-benzidine, and bordeaux shades with the para-aminoanilide of beta-oxynaphthoic acid.

One feature of this method of dyeing is that there is a possibility of forming more than one azo compound as a result of the self-coupling. Fortunately these variations will have approximately the same shade so that this is not a very important matter especially if the conditions of self-coupling are maintained constant from batch to batch of material. The following shows how the various azo bodies may be formed, it being possible for a molecule of the diazotized amino substance to couple with one or more adjacent similar molecules before the azo linkage returns to itself. (See top of next page)

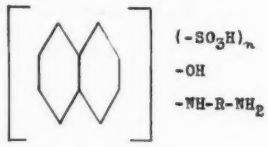
The above self-coupled azo dyes increase in molecular complexity and will probably similarly decrease in water-solubility so as to give faster shades to washing.

Such self-coupled azo dyes are amenable to after-treatment with metal (for example, copper) salts for increasing their fastness to various influences.

In the more recent progress along these lines, use has been made (E. P. 503,134) of aromatic bases which can be applied to the wool from neutral or feebly alkaline



solutions having no adverse effect on the handle of the wool and which can then be diazotized and self-coupled. These bases are of the general formula:



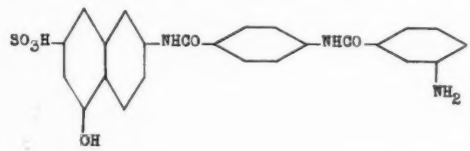
where *R* may be one of the following:

—CO—Aryl
—CO—Aryl—NHCO—Aryl—
—CONH—Aryl—NHCO—Aryl—
—CONH—Aryl—NHCONH—Aryl—
—CO—Aryl—NHCONH—Aryl—

It is the presence of the sulfonic acid groups (SO_3H) which allows less alkali to be used for the solution of these substances.

One advantage of these substances is that they can be applied not only to wool but also to mixtures of this fiber with rayon staple fiber and then yield (on diazotization and self-coupling) solid shades—a matter of some importance for it is not easy by ordinary methods to dye such mixture materials in solid shades of excellent fastness. The following two examples illustrate the dye principles involved and the types of aminonaphthol found satisfactory.

In order to obtain a deep red-orange shade of good fastness on a yarn consisting of a mixture of 70 per cent wool and 30 per cent viscose staple fiber, this material is first worked for one hour in a bath at 85° C. containing ammonium sulfate and the sodium salt of 3"-amino-4'-benzoylamino-2-benzoylamino-5-hydroxynaphthalene-7-sulfonic acid having the following formula:

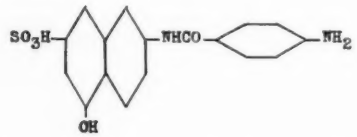


The bath is then cooled to 70° C. and some Glauber's salt added. The yarn is then hydro-extracted and treated in a cold fresh bath containing

30 parts of sodium nitrite
80 parts of 85 per cent formic acid
30 parts of a wetting-out agent
30,000 parts of water

until diazotization is complete (about one-half hour). The yarn is again hydro-extracted and then developed in a dilute solution of ammonia whereupon its orange red color appears.

By using a similar process of dyeing but by replacing the above-mentioned aminonaphthol with the sodium salt of 4'-amino-benzoyl-1-amino-7-hydroxy-naphthalene-4-sulfonic acid the wool mixture material can be dyed a brilliant scarlet red shade. This particular aminonaphthol has the following formula:



and may be prepared by reacting 2-amino-5-hydroxy-naphthalene-7-sulfonic acid with phosgene and para-acetanilide, followed by saponification of the product.

It is evident that this new method of dyeing wool with azoic dyes produced within the fiber by diazotization and self-coupling has certain advantages which suggest that it is a method deserving attention so that one of its main disadvantages (limitation of shade from yellow to red) may be overcome.

TRADE NOTES • NEW PRODUCTS

• NEW CALCO BULLETIN

Calco Chemical Company Division, American Cyanamid Company has released a new technical bulletin No. 549, "Calconese Colors for Textiles." Tables showing the fastness properties are given for both nylon and acetate rayon. Since the changes under artificial light on nylon dyed with acetate colors are usually distinct, the bulletin includes a list of changes from daylight to artificial light.

Because of the growing importance of nylon this bulletin is of considerable timely interest. Copies are available on request to Calco.

• RHOTEX A-20

Rohm & Haas Co., Inc., 222 W. Washington Square, Philadelphia, Pa., have recently issued a leaflet concerning the use of RHotex A-20 for textile printing. This is a new synthetic thickening agent developed especially for this purpose, which is said to give increased color value and smoother, longer print pastes. It is claimed that by substituting this water soluble synthetic resin for a portion of the British gums used in vat printing, color values are improved from 15 per cent to 30 per cent, thus making possible substantial cost reductions. It is further claimed that RHotex A-20 not only produces greater

depth of color, but in many cases increases the brightness of the color. The leaflet gives information concerning the properties, formulas and method of preparing the paste. Copies are available upon request.

• BOSTON OFFICE, A.A.P.

On and after April 27th, the Boston office of American Aniline Products will be located at 190 High Street.

• PHILADELPHIA TEXTILE ALUMNI

Forty former students of Philadelphia Textile School met on April 4th in New York and formed the New York Club of Philadelphia Textile School. Representatives were in attendance from classes as early as 1887 and as late as 1939. Milton Schmidt of E. F. Timme was elected president; Dr. George E. Linton of Central Needle Trades High School, vice president; Howard P. Galloway of *Textile World*, secretary; and Benjamin Prager of L. Bachmann & Co., treasurer.

Present plans of the group call for meetings to be held quarterly. However, due to the necessary detail in starting a new organization, it was decided to hold two more meetings before curtailing activities for the summer. At the first of these, scheduled for May 15, detailed plans for Club-School cooperation will be discussed. At the last meeting of the season, to be held shortly thereafter, M. E. Heard, new dean of Philadelphia Textile School, will be the honored guest and speaker.

• 1940 INDEX TO STANDARDS

The latest edition of the "Index to A.S.T.M. Standards, Including Tentative Standards" gives information on all of the 885 standards as of January 1, 1940. The index is of service to anyone wishing to ascertain whether the society has issued standard specifications, test methods, or definitions covering a particular engineering material or subject and it is of help in locating the standards in the volumes where they appear. Copies of this 152 page publication are furnished without charge on written request to A.S.T.M. headquarters, 260 S. Broad Street, Philadelphia, Pa.

• LONGSTRETH MEDAL

Games Slayter of Newark, Ohio, is to receive an outstanding honor from The Franklin Institute for his development of Fiberglas.

On May 15th, Mr. Slayter will be awarded an Edward Longstreth Medal during the annual Medal Day exercises of The Franklin Institute, Dr. Henry B. Allen, secretary and director of the Institute, announced recently. The medal is given, "in recognition of meritorious work in science and the industrial arts," on the recommendation of the Institute's Committee on Science and the Arts, Dr. Allen said.

Mr. Slayter is vice-president of Owens-Corning Fiberglas Corporation, Toledo, Ohio, and is in charge of research and development. At least eight principal United States patents in the Fiberglas field have been issued in his name.

The Longstreth Medal will be the second outstanding honor which Mr. Slayter has received this year for his development of Fiberglas. Last February he was given an award as a Modern Pioneer which was presented to leading inventors and research workers by the National Association of Manufacturers.

• NEW NYLON PATENT

A patent covering production and processing of a crimped wool-like fiber made of nylon was issued recently by the United States Patent Office, it was announced by E. I. du Pont de Nemours & Company, Inc. The patent was issued to John Blanchard Miles, Jr., Du Pont scientist, and assigned to the Company.

The nylon crimped fiber is made from the same basic elements obtained from coal, air and water as other nylon products, including textile fibers for hosiery, bristle-like filaments for brushes and other materials. It is said to approach, "and may even equal," wool in "crimp retentivity" and heat insulating properties. Superiority in strength, heat stability and dyeing characteristics are other qualities claimed. It also is said to be elastic, mothproof and unaffected by commonly used cleaning fluids or processes.

E. K. Gladding, Manager of the Nylon Division of the Du Pont Company, said that there is no immediate commercial production of the new fiber planned. Such production will require new types of manufacturing equipment, all of which must yet be designed and built.

The patent issued covers the conversion of filaments formed from synthetic linear condensation polymers, particularly polyamides, into wool-like fibers by mechanical methods of "crimping" either prior to, during, or following the "cold-drawing" process which is used in manufacturing nylon yarn. In general, the patent states that at least four crimps per inch are required to obtain a wool-like material, although some methods of crimping covered by the patent produce ten or more crimps per inch.

Retention of the crimp after the stretching that occurs in normal use is improved by hot water or steam "setting" treatments, such as are described in other nylon patents.

It is pointed out that the new fiber lends itself to preparation of mixed fibers, and that delusterants added during manufacture tend to improve its appearance.

• FIFTIETH ANNIVERSARY

The officers and directors of Stein, Hall & Co., Inc., manufacturers and distributors of starches, gums and dextrines, tendered a banquet on April 6th to Frank Griswold Hall, President, in celebration of the 50th anniversary of his association with the Company.

F. G. HALL

The banquet was held in the Jansen Suite of New York's Waldorf-Astoria Hotel just a half century from the day when Mr. Hall's reply to a newspaper "help wanted" ad won him a $9-a-week job with the late Leo Stein, who in 1889 had opened a New York office for Stein, Hirsh & Co., the original Company, organized in Chicago in 1866. Stein-Hall will celebrate its 75th anniversary next year.

Mr. Hall's letter of application, in which he used only 66 words to express his desire for "a position with a good chance for advancement," was reproduced in the souvenir menu brochure above this sentence, "He got the job."

Mr. Hall had already marked his golden anniversary by presenting to every employee and representative in this Country and Canada, in Batavia and Sourabaya, Java, and in Rotterdam, Holland, a beautiful gold pencil in token of his deep appreciation of their cooperation in building Stein-Hall's success.

In behalf of all the Stein-Hall organizations, W. W. Strasser, executive vice-president, presented to Mr. Hall a gold loving cup and a set of engrossed resolutions which extolled his invaluable services for the Company and expressed richly deserved esteem for his fine qualities as a man.

Mr. Hall also received a handsome traveling clock, the gift of Handelsvereeniging of Amsterdam, Holland, for whom Stein-Hall are agents in the United States and Canada.

The climax of the program was reached when Mr. Hall responded with a heartfelt expression of gratitude to all who had cooperated with him down the years.

Under the genial toastmastership of Arthur L. Strasser, the company's general counsel, tributes were paid to Mr. Hall

by the officers and directors; Oliver H. Clapp, chairman of the Junior Committee representing the employees; Louis E. Leverone, vice-president and general manager, Stein-Hall Mfg. Co., Chicago, and others. About 50 members of the Stein-Hall staff were present including the branch managers; Ira L. Griffin, Charlotte, N. C.; Elliott I. Stokes, Philadelphia; R. D. Armstrong, Boston; J. A. King, Providence; and Warren B. Gager, Rochester, N. Y.

Among the hundreds of congratulatory messages received by Mr. Hall, those read at the banquet included cablegrams and letters from Mrs. Gerda Stein, widow of Leo Stein; members of the staff of Hall Trading Corp.-"Rotterdam," of Batavia and Sourabaya, Java; Handelsvereeniging of Amsterdam; J. A. Koolhoven and Mr. and Mrs. Johann de Roos, Hall Trading Corp.-"Rotterdam," of Rotterdam, Holland.

The employees of all the Stein-Hall organizations had previously expressed their sincere affection for the president by presenting to him a gold plaque and a set of Lenox china service plates bearing etchings of famous horses and inscribed with the name of the artist.

Organized by Solomon Stein and Morris M. Hirsh, the original Company was already 24 years old when Mr. Hall became office boy, stock clerk and salesman for Leo Stein. The steady growth of the New York business justified a division of the Company into two partnerships, one in Chicago and one in New York, and Mr. Hall became Leo Stein's partner in the New York business.

Solomon Stein died in the early years of the company and Mr. Hirsh retired on January 1, 1918. The name was then changed to Stein, Hall & Co. and the business was incorporated. In March of that year Leo Stein was stricken with pneumonia. He died within a few days and Mr. Hall succeeded to the presidency.

The New York company, with headquarters at 285 Madison Ave., has branch offices in Boston, Philadelphia, Providence, Charlotte, N. C., and Rochester, N. Y. The Chicago business is now known as Stein-Hall Mfg. Co., and the Canadian business as Stein-Hall, Ltd., Toronto. The facilities of the Company's gum and dextrine factory and laboratory in Long Island City, conducted under the name of Stein-Davies Co., have recently been enlarged by the construction of a five-story addition.

• JOINS HART PRODUCTS

Sidney Edelstein has recently joined the research staff of Hart Products Corp.

Mr. Edelstein was formerly chemist for the Dixie Mercerizing Co. of Chattanooga, Tenn., and was Research Associate for the A.A.T.C.C. working on the "Study of the Mercerization Process" for two years. For the past two years Mr. Edelstein was Vice President and General Manager for Lamed, Inc., manufacturers of Lanolin.

Mr. Edelstein has also given a course of lectures on textile chemistry at the University of Chattanooga. He has to his credit a number of technical publications and patents on textile subjects. He is a graduate of the Massachusetts Institute of Technology.

• A.I.C. MEDAL

The medal of the American Institute of Chemists, presented annually for outstanding service to the science of chemistry and the profession of chemist in America, has been awarded this year to Dr. Gustav Egloff, director of research, Universal Oil Products Company, Chicago, Illinois, according to an announcement made recently by President Robert J. Moore, from the Institute's office at 233 Broadway, New York, N. Y. The award is made in recognition not only of Dr. Egloff's work in developing some of the most outstanding processes for the refining and treating of crude oils and gasoline; for the prodigious amount of publications in the field of petroleum and hydrocarbon chemistry, amounting to over four hundred articles and books; for the issuance to him of over two hundred and fifty patents relating to the processing of petroleum oil, shale oil, coal, and chemical derivatives of hydrocarbons, which are invaluable to the research workers in chemistry, but also for the outstanding service which he has given to the advancement of chemists.

The medal will be presented to Dr. Egloff at the annual meeting of The American Institute of Chemists to be held at Atlantic City, New Jersey, May 18, 1940.

• JOINS CAROLINA

Felix A. Tomalino will head the newly formed Mert department of the Carolina Aniline & Extract Co., Inc., Charlotte, N. C. He assumed the head of this department April 15th. It is understood the company has made patent applications on two new products which will be under his sales supervision. Mr. Tomalino has had many years experience in the textile dyeing industry and his family have been well known for several generations in the textile trade.

The new department of the Carolina Aniline & Extract Co., Inc., will carry this company's activities beyond the textile field into unrelated industries.

• JOINS U. S. ASBESTOS

Giles E. Hopkins has been appointed Technical Director of the U. S. Asbestos Division of Raybestos-Manhattan, Inc.

Mr. Hopkins was with the Bigelow-Sanford Carpet Company as Chemical Engineer and Technical Director for 11 years before his present association with the United Shoe Machinery Corporation.

He will take up his new responsibilities in the Manheim, Pennsylvania, laboratories on May 1st.

• CLASSIFIED ADVERTISEMENTS •

The rate for "Position Wanted" advertisements in this column is 2 cents a word—with a minimum of 50 cents per insertion. For all other types of advertisements—i.e., help wanted, machinery or supplies for sale—the rate is $5.00 per column inch or less per insertion.

POSITION WANTED: Dye and chemical salesman covering N. E. Textile Mills, well-known in the trade, will represent manufacturer in this territory on a commission basis, selling product with repeat sales possibilities. Write Box No. 236, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

POSITION WANTED: Sales engineer with eight years' experience in selling industrial automatic controls and drying equipment. Write Box No. 243, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

APPLICATION CHEMIST WANTED: Position with large manufacturer open to man specializing in dyeing and printing naphthols, with laboratory and mill experience background. Furnish complete particulars in letter of application—confidential. Write Box No. 244, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.